E3 Equipment Energy Efficiency

Technical Appendices – Consultation Regulation Impact Statement for the energy efficiency of electronic displays

Televisions, computer monitors and digital signage displays

2023

A joint initiative of Australian, State and Territory and New Zealand Governments.

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This document is available at the Department of Climate Change, Energy, the Environment and Water's consultation website.

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Appendix C - Data sources and assumptions for cost-benefit analysis modelling

Overview of data sources

A wide range of data sources were used to establish the characteristics of new products sold into the Australian and New Zealand markets. These are briefly described below.

Televisions – key data sources include:

- Registration data submitted since 2009 (Australia and NZ)
- GfK sales data 2007 to 2020 – this covers the whole Australian retail market
- NZ sales data matched to registrations since 2013
- EU data for 10,331 models is also available as a reference (as at September 2022)
- Long term monitoring of television viewer habits from OzTam in Australia and a range of other end use data sources.

Computer monitors – key data sources include:

- Registrations data submitted since 2013 (Australia and NZ)
- GfK monitor sales data 2010 to 2020 – this covers the whole Australian retail market
- NZ sales data matched to registrations since 2014
- EU data for 3,625 models is also available as a reference (as at September 2022).

Digital signage displays – key data source includes:

- European EPREL database of signage displays which includes EU registration data and energy performance data for 664 models (as at September 2022)
- Data from local service providers and contractors.

Methodology for the analysis of the data

The available data provides a comprehensive view of the trends in energy and other key characteristics over time in Australia and New Zealand. This section briefly describes the process of data analysis.

Registration data

Suppliers are required to register models within the scope of the regulations with the Australian or New Zealand government prior to offering products for sales. This provides a useful database of technical data for these products. While the characteristics of products registered in each year does provide some indication of characteristics and trends over time, the registration data does not provide any indication of the level of sales for each model registered. Some models registered may have large sales or may have no sales, so registration data alone needs to be considered as largely qualitative in nature.

New Zealand sales data

NZ regulations require importers and manufacturers to annually report NZ sales of each model registered for all products regulated. For this project, EECA provided anonymised performance data and sales for each relevant registration record (televisions and computer monitors). This was used to established sales weighted characteristics over the period 2014 to 2021 for New Zealand.

Australian sales data

The main source of sales data in Australia was purchased from a market research organisation called GfK. For this analysis, sales data sets were obtained for televisions, computer monitors and computers (mainly to assess the underlying demand for computer monitors).

Australian television data

GfK television sales data includes screen technology, screen size (diagonal in inches) and label energy (CEC). As the data set started in 2007 (prior to the energy regulation of televisions), many of the records up to 2010 did not include any energy data. However, energy data was fairly complete from around 2011. A check against the registration system by model found that this energy data was generally correct – the discrepancies found were relatively few (~6% of models had some small issues) and generally the differences were relatively minor (virtually all models where model number was known could be matched to registration records).

In the years 2018 to 2020, 97% of all sales had energy data (CEC) recorded by GfK and this percentage was fairly constant since 2011. For televisions where model data was provided, this was cross matched to the registration database to enable additional characteristics to be analysed. Of the 846 models listed for sales in 2018 to 2020, only 8 models could not be matched to an applicable GEMS registration.

The sales of models where registrations could be matched represented 75% of all sales (the balance being listed "Tradebrand[1]" without model and/or brand details). There was a difference in sales weighted energy of all GfK records with energy recorded and those that were matched via registrations. The difference was around 7% lower for the GfK energy values. However, further examination of the data

[1] In GfK data sets, models that are unique to a specific supplier are denoted as Tradebrand to maintain commercial confidentiality. In most cases, Tradebrand records still record key attributes for analysis size as size, technology and energy consumption.

compared the sales weighted energy as recorded by GfK versus the sales weighted energy using registration data where both energy values were known. This data showed that these two energy values were generally within 1 kWh/year of each other.

This suggests that the models that did not have a model number listed (denoted as Tradebrands in the GfK data set) tended to be smaller, cheaper and slightly lower energy, which is as expected. This validation process shows that the GfK energy value as recorded can be used for robust bottom up analysis (noting some small discrepancies at an individual model level in a few cases).

The GfK television data set starts in 2007 and this enabled tracking the major technology transition during the period 2007 to 2013 as well as size trends by technology. The GfK sales data also shows the retail price paid for each model in each year. This allowed a detailed analysis of any impact of efficiency or energy consumption on the product price to be undertaken.

GfK monitor data included technology and screen size as well as other features like whether the monitor is set up for gaming and whether the screen is curved but no energy data was included in this data set. GfK monitor model data was cross matched to the registration database. Around 500 models were successfully cross matched for sales over the period 2015 to 2020. From this analysis it appears that the GfK sales data includes quite a few monitors that are out of the current scope of the regulations (professional monitors, large gaming monitors, tablets) – around 50% of sales were matched to the registration data, giving reasonable trend sales weighted data on key attributes for products covered within the scope. It was noted that the screen technology recorded by GfK did not differentiate between LCD and LCD (LED) – only LCD was recorded. Sales data from Australia and NZ show that around 20% of sales were LCD whole 80% of sales were LCD (LED) for monitors.

EU EPREL database

Since 2022, Europe requires registration of products regulated in Europe and submission of data to regulators. This is now listed on [the EPREL - European Product Registry for Energy Labelling].

The EPREL database contains 10,331 television models, 3,625 computer monitor models and 664 signage display models as of early September 2022. This data provided a useful reference for checking key attributes such as the presence of Automatic Brightness Control (ABC), which is not recorded in the television registration system in Australia and New Zealand (but it is recorded in the computer monitor database, but with no performance data on the energy impact of ABC).

Emissions intensity

Australia

This CRIS uses the emissions intensity from the Decision RIS (DRIS) on the National Construction Code (NCC) 2022[2], as illustrated in Figure 1. Emissions are assumed to be zero after 2050. The NCC 2022 DRIS bases its emissions intensity for electricity on the 2021 emissions projections produced by the then Department of Industry, Science, Energy and Resources[3].

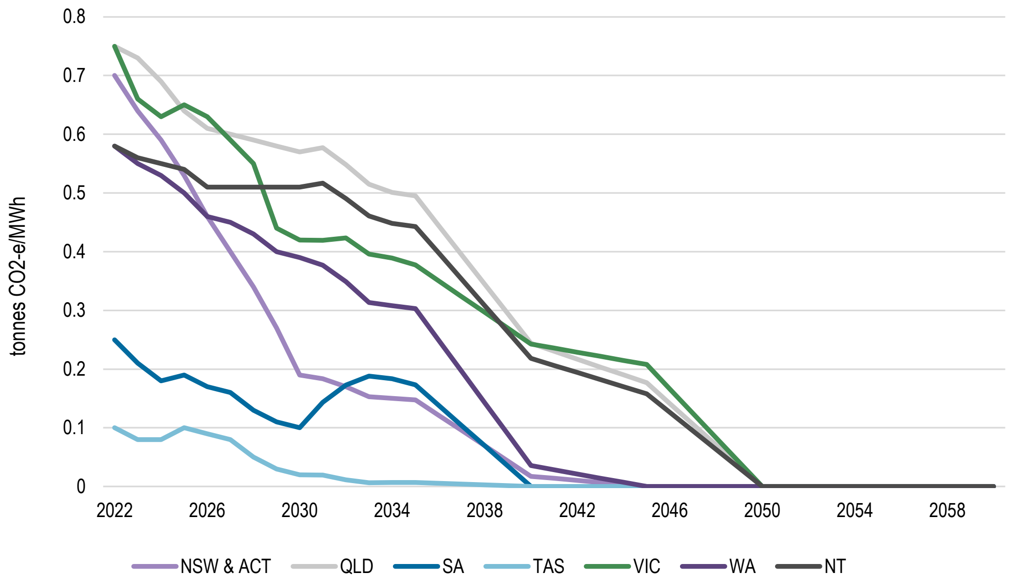

Figure 1: Electricity emissions factors over time, tonnes CO2-e/MWh. These units are the same as kg CO2-e per kWh. (NCC DRIS 2022 Figure 5.19)

New Zealand

For New Zealand, EECA has provided projections of emission intensity out to 2050 as part of their Current Policy Reference scenario developed by the NZ Climate Change Commission[4] as illustrated in

Figure 2.

[2] ABCB NCC 2022 Decision RIS

[3] Australia's emisssions projections 2021

[4] See this NZ spreadsheet for details

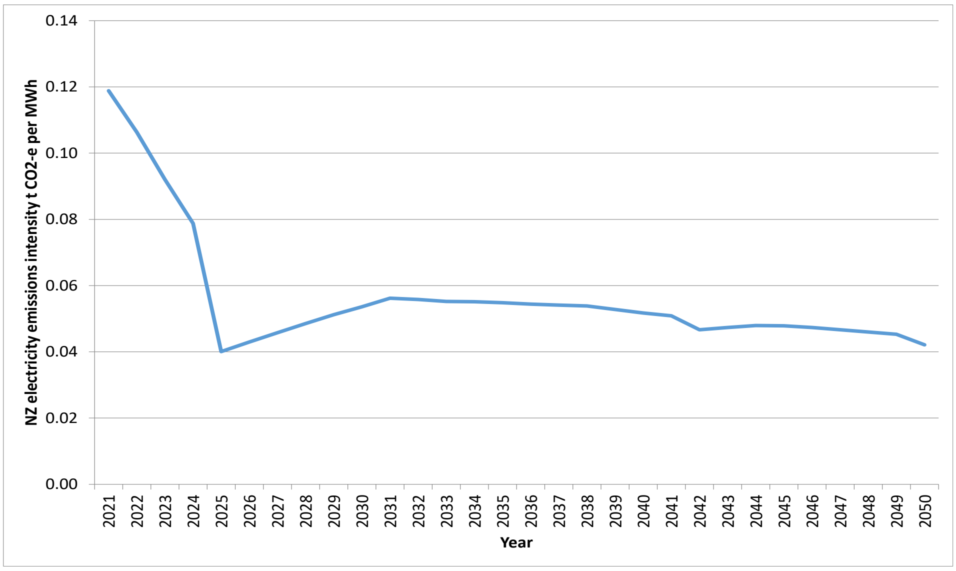

Figure 2: Projected electricity emissions intensity for New Zealand

Discount rates

Australia

In Australia, the Office of Impact Analysis[5] (OIA) requires the calculation of net present values at an annual central real discount rate of 7%[6], with sensitivity analysis conducted using a lower bound discount rate of 3% and an upper bound discount rate of 10%. This is the same central value and range as used in the NCC 2022 DRIS.

New Zealand

A central discount rate of 5% with sensitivity analysis for different discount rates of 2% and 8% has been used in this CRIS. NZ Treasury provides guidance on discount rate selection on their website[7].

Electricity costs – residential

Australia

The residential electricity costs used in this CRIS were based on projections developed for the NCC DRIS 2022[8], as shown in Figure 3.

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[5] Formerly known as the Office of Best Practice Regulation (OBPR).

[6] OIA Guide to environmental valuation

[7] NZ Treasury advice on discount rates

[8] ABCB NCC 2022 Decision RIS

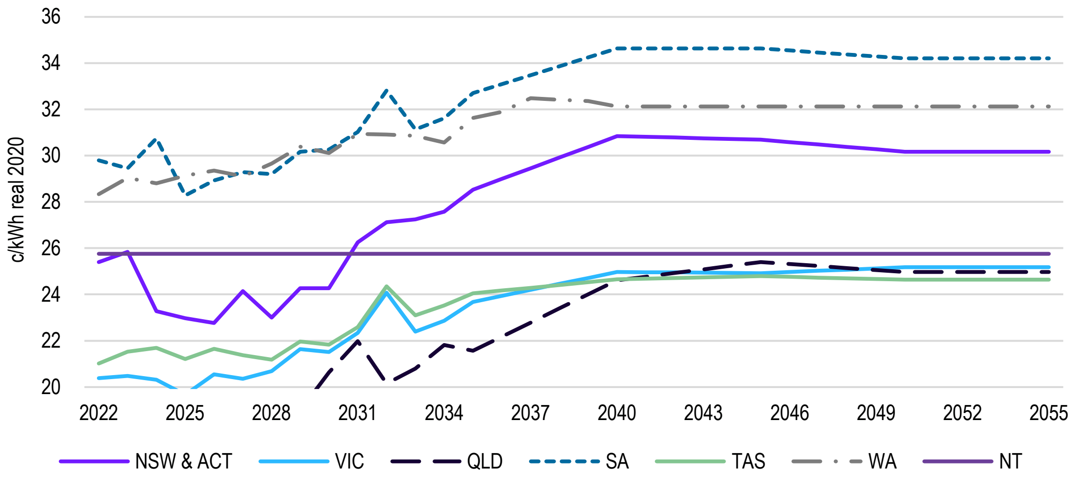

Figure 3: Projected real residential electricity prices by state and territory (real 2020 AU dollars) (Figure 5.15 NCC DRIS 2022)

New Zealand

The long run marginal cost[9] of electricity was used for all sectors in this CRIS. EECA provided projections of the long run marginal cost of electricity out to 2040 as projected by the New Zealand Ministry of Business, Innovation and Employment (MBIE). This data indicates that real prices are expected to be reasonably constant from 2022.

Long run marginal costs were used for NZ to estimate national net benefit, which compares the marginal cost of electricity production to the additional cost of production of the energy using end use devices. For this analysis, a wholesale product price factor of 0.45 is assumed. That is, the expected increase in retail price is factored down as an estimate of production cost increase. It is assumed that there is no increase or decrease in these real energy cost projections when assessing the future costs and benefits in this RIS.

Electricity costs – commercial

Australia

Commercial sector electricity tariffs are more variable than the residential sector. To some extent the tariff will depend on the size of the business and the offerings of local energy retailers. A review of commercial tariffs offered by larger electricity retailers found that commercial sector electricity tariffs varied from 0.9 of the residential tariff to 1.3 times the residential tariff in each state. A specific state ratio was developed for each state and territory based on representative values for

[9] Provided by the New Zealand Ministry of Business, Innovation and Employment

residential and commercial sector tariffs as set out in Table 1 and this was assumed to apply to future electricity price projections.

Table 1: Ratio of commercial electricity tariffs over residential electricity tariffs by jurisdiction[10]

State	Ratio Commercial/ Residential
NSW	1.296
VIC	1.129
QLD	1.303
SA	1.206
WA	1.107
TAS	0.908
NT	1.164
ACT	1.214

New Zealand

The long-run marginal cost[11] of electricity was used for all sectors in this CRIS.

Treatment of Goods and Services Tax

Retail prices for products covered by this RIS (electronic screens) and electricity purchases include Good and Services Tax (GST). This is currently 10% in Australia and 15% in New Zealand.

In Australia, for the residential sector, the product cost and energy cost including GST are used in the calculations. For the commercial sector, product cost and energy cost excluding GST are used in the calculations as businesses can claim any GST paid as an input credit.

For New Zealand, GST is not included in the analysis as this is done on a whole of economy basis which ignores taxation effects.

[10] For NSW, Victoria, Queensland and South Australia, data from the ACCC Inquiry into the National Electricity Market - May 2022 report was used (Appendix E: Supplementary spreadsheet with billing data) as well as tariff data from the Australian Energy Regulator (Market Retail Report 2020-21). For WA data was obtained from Energy Policy Wa For Tasmania, data was obtained from Aurora Energy. For NT data was obtained from Power Water - Power pricing and tariffs. For the ACT data was obtained from Energy Made Easy.

[11] Provided by the New Zealand Ministry of Business, Innovation and Employment

Emissions pricing

Australia

The burden (costs) of greenhouse gas (GHG) emissions are almost entirely borne by third parties (neither the consumer, nor the electricity generator). This is an example of an economic externality. As set out in the NCC 2022 DRIS, there are multiple approaches to estimate the cost of GHG emissions. The value of GHG emissions, therefore, is not internalised in the market, which means that individuals do not make decisions based on the overall impact. This is a classic market failure, making the value of emissions difficult to estimate accurately.

This CRIS has adopted the same approach used in the NCC 2022 DRIS, which is based on a social cost of carbon. It sets out four scenarios called Low, Medium, High and High Impact which provides a time series of carbon price from 2020 to 2050. The medium case has been used as the central case for economic modelling in this CRIS, with other cases used to test sensitivity. The values used and the underlying assumptions are set out in Section 5 and Table 5.25 of the NCC 2022 DRIS[12].

New Zealand

For New Zealand, the Treasury's Shadow Price of Carbon[13] Low, Central and High scenarios were used in the cost benefit analysis.

Network Benefits

The implementation of upgraded energy efficiency standards will result in a reduction in peak demand on the electricity supply network for all products covered. The deferred transmission network benefits have been estimated using the same transmission deferral benefit as used in the NCC DRIS 2022. A conservative value of AU$500/kW reduction has been used to estimate network benefits from peak load reductions in Australia. An equivalent value of NZ$230/kW has been used for New Zealand, based on advice from EECA.

The peak demand reduction is estimated on the basis of average demand reduction for computer monitors and signage displays with a peak load reduction factor of 1.2 as their use will primarily be during the day. For televisions the peak load reduction factor has been estimated at 2.5 times the average demand reduction, as this occurs primarily during the evening peak.

[12] ABCB NCC 2022 Decision RIS

[13] Page 78 CBAx Tool User Guidance Guide for departments and agencies using Treasury's CBAx tool for cost benefit analysis October 2022

Health Benefits

The NCC DRIS 2022 examined and quantified the health benefits from a reduction in electricity and gas consumption, noting that that RIS was focused primarily on space heating and cooling, which has significantly higher energy use than electronic displays. The mining and combustion of coal for electricity generation in Australia produces air pollution containing particulate matter, nitrogen oxides, sulphur dioxide, as well as other emissions. These can cause health problems such as respiratory illness and can also affect local economies. Particulate matter, sulphur dioxide and nitrogen oxides are the main power station emissions contributing to health damage costs. These emissions are associated with respiratory and cardiac diseases. That RIS used a value of $2.58 per MWh of electricity generation from coal fired power stations in all Australian states (equivalent to 0.285 c/kWh or $2,580 per GWh).

An initial investigation showed that the health benefits arising from the implementation of energy policies for electronic displays were quite small because the future share of coal generation is declining rapidly. When the expected share of coal generation from 2022 to 2050 by state was applied to the estimated electricity savings by state, the net present value of the health benefits were small (around 0.2% of other program benefits). Health benefits are therefore not explicitly included in the quantified benefits of this CRIS.

Administration and testing costs

Implementation of the GEMS program and the associated energy efficiency requirements in Australia and New Zealand has costs associated with administration, compliance and testing. The types of cost impacts include:

- Direct supplier costs for the registration of products (fee to government)
- Direct administrative costs for suppliers to compile data and test reports and submit this data to government in their registrations
- Direct supplier costs to commission testing of products for registration
- Government administration costs for operating the registration system (over and above any registration fee charged) plus policy development and support work
- Government compliance costs for surveillance and check testing (monitoring, verification and enforcement)
- Transition costs for retailers and suppliers, including publicity associated with the transition to the new efficiency standards and energy label.

In order to estimate these types of costs, a base case of the number of registrations (historical and projected) was developed based on registration data to date.

Historical and projected number of registrations by product type for the base case and for the case with new regulations are shown in Figure 4.

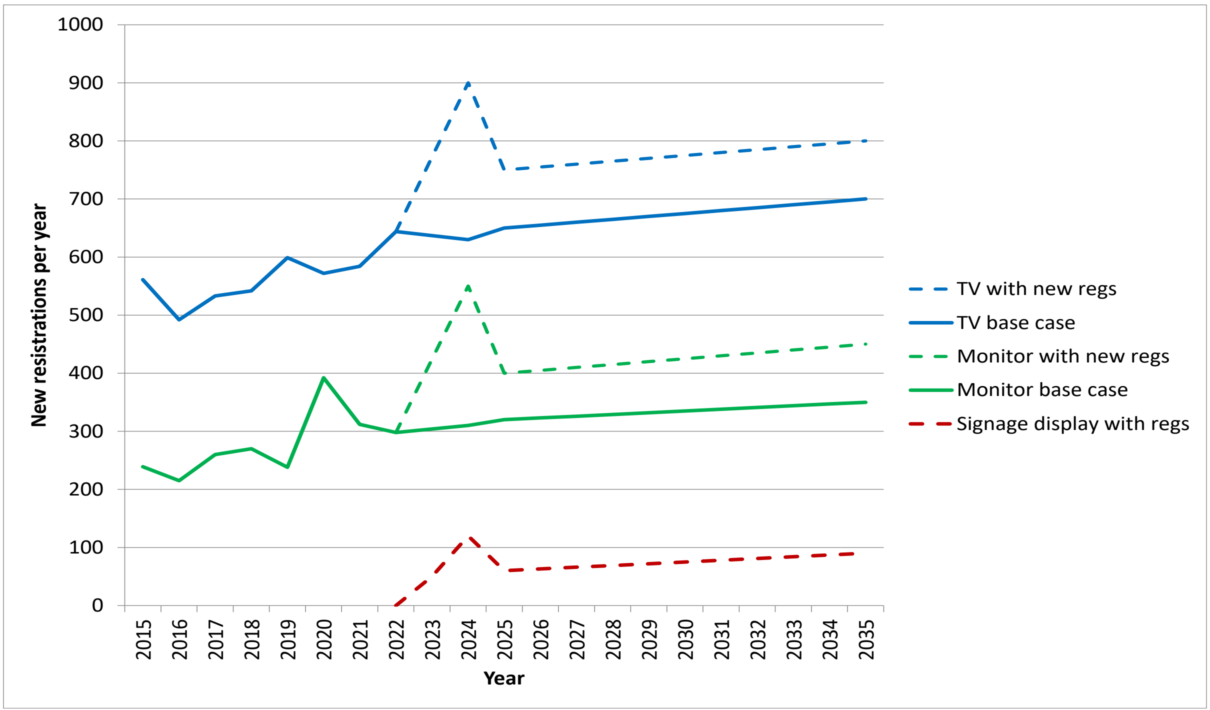

Figure 4: Projected number of new registrations per year for the base case and for new regulations[14]

All costs were estimated on a per registration basis, except for transition costs, which were one off costs allocated over the period 2023 to 2025. Historically, the share of New Zealand registrations is typically less than 5% for these products, so the historical share was projected into the future for both cases. While New Zealand does not charge a registration fee, the total administrative costs are assumed to be the same. The total cost per registration for all elements is estimated to be AU$4,425. The one-off transition costs allocated for the cost benefit analysis were $AU4.1 million for Australia over 2023 to 2025 and NZ$1.1 million for New Zealand over the same period.

Costs associated with the preparation of legislation, regulations or changes to the online registration system have not been quantified or included in these costs.

Other non-quantified benefits

There are a range of other secondary benefits that are likely to flow from the implementation of increased efficiency standards for electronic displays. Some of

[14] Includes new registrations for Australia and New Zealand combined. Actual data to 2022 with trend projections for the base case. Signage displays have no registrations in the base case because they are currently not regulated, so the number of registrations is estimated.

these are small and some are quite indirect. Many are complex to calculate. The likely secondary benefits that have not been explicitly quantified for this RIS include:

- Indirect health benefits from the reduction of fossil fuel generation generated from program energy savings (a preliminary assessment showed these were relatively small)
- Macroeconomic effects where expenditure and investment options are available using the monetary value of energy savings
- Effects of reduced household energy consumption leading to lower energy bills and reduced financial stress – reduced energy bill pressure, fewer disconnections, improved mental wellbeing and improved health by potentially freeing up money for food
- Changes in wholesale electricity prices or investment in generation caused by changes in electricity demand resulting from the policy
- Improved electricity system reliability.

Appendix D - Modelling

Overview

The cost-benefit analysis for this CRIS uses stock models. Stock models are used to model equipment energy use, product costs, energy bills, GHG emissions and other key parameters for the whole stock of installed products. Stock models also allow adjustments to changes in ownership and the total number of households or business over time. They keep track of products that are currently in-use as well as retirement of older products from the stock at the end of their lifetime, and new and replacement purchases.

Baseline input data and technology characteristics for televisions

While the markets in Australia are New Zealand are fairly similar (as expected), there are some differences and these differences were quantified and included in the modelling of energy impacts in this CRIS.

Televisions underwent a massive shift in technology from about 2003, when flat screen televisions became widely available. From the time of their invention in the 1930s, all televisions in households used cathode ray tube (CRT) technology to generate a picture. Broadcasts in Australia started with the Melbourne Olympics in 1956 and while there was a change from black and white to colour in 1975, the technology used for televisions remained largely unchanged for around 80 years. CRT televisions were bulky and there was a limit on the screen size possible. The main technologies used for televisions are:

- CRT: cathode ray tube televisions – largely disappeared by 2010.
- Forward and rear projection televisions – negligible sales even before the transition to flat screens in the early 2000s so are not discussed any further.
- Plasma televisions: the screen contains tiny pockets of gas which turn into a plasma state and emits UV lights when a voltage is applied, which hits phosphor cells to produce coloured pixels – plasma televisions had mostly disappeared by approximately 2015.
- LCD: liquid crystal display – this is a solid state screen technology where the screen transparency for each pixel can be changed by an electrical signal with the resulting image produced using a backlight (usually fluorescent lamps).
- LCD (LED): liquid crystal display but with a backlight provided by an array of LED lamps rather than fluorescent lamps.

- OLED: organic light emitting diode is based an organic substance used as the semiconductor material in light-emitting diodes (LEDs) that generate individual pixels of light.
- QLED: quantum dot televisions (QLED) – these are a form of LCD (LED) television where the LCD screen is made up of semiconducting nanocrystals that can more precisely filter light transmitted through the LCD screen to enhance the picture quality and resolution (enhanced colours). In practical terms they are similar to LCD (LED) screens.

Sales data for Australia by screen technology from 2007 to 2020 shows the extent of this transformation, as illustrated in Figure 5.

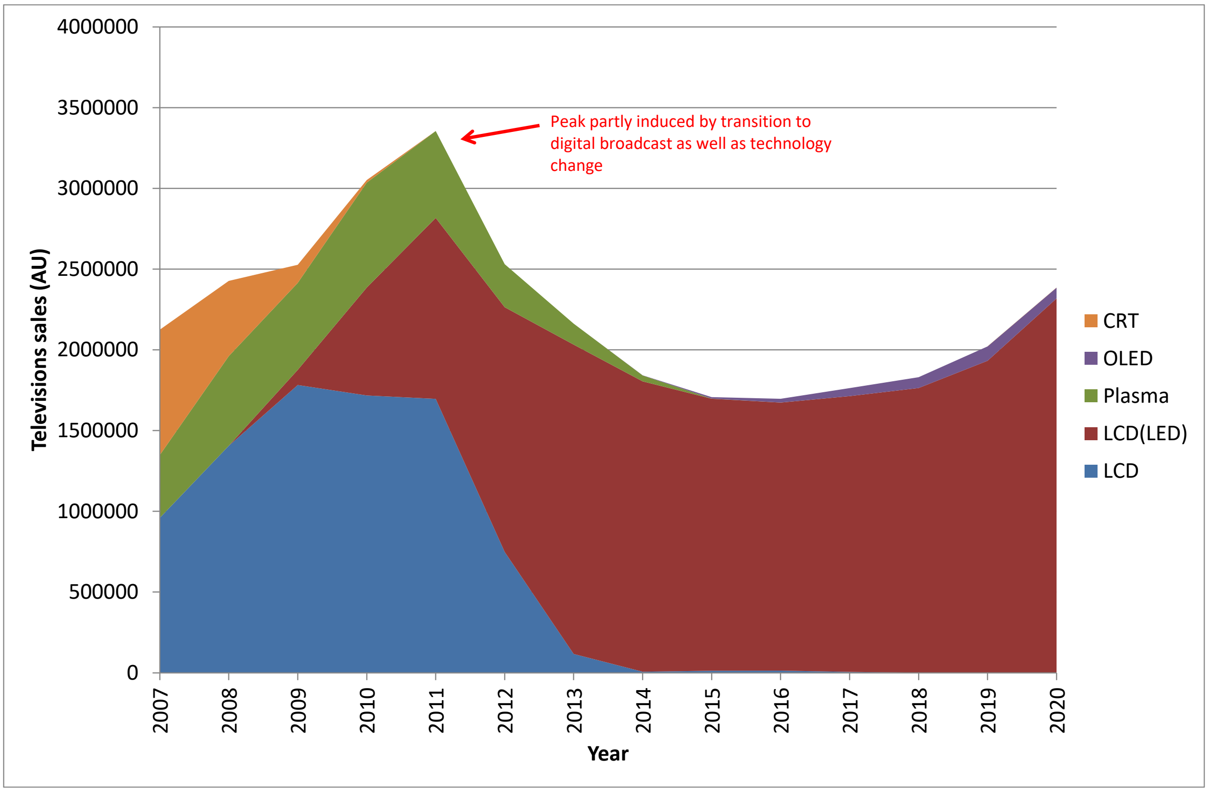

Figure 5: Sales of television by technology in Australia (based on GfK sales data)

CRT televisions largely disappeared by 2010 and plasma televisions, while enjoying a surge up to 2011, disappeared by around 2015. Plasma televisions were popular at the time with television enthusiasts due to their large screens and bright pictures, but their energy usage was quite high. LCDs with fluorescent backlights had also more or less disappeared by 2014, leaving LCD (LED) as the dominant technology. OLED screens appeared in 2015 in significant numbers and quickly established themselves in the larger screen segment where screen brightness is important. OLEDs now make up around 5% of sales in Australia and New Zealand. The equivalent data for New Zealand is shown in Figure 6 which shows a similar peak, but a few years later.

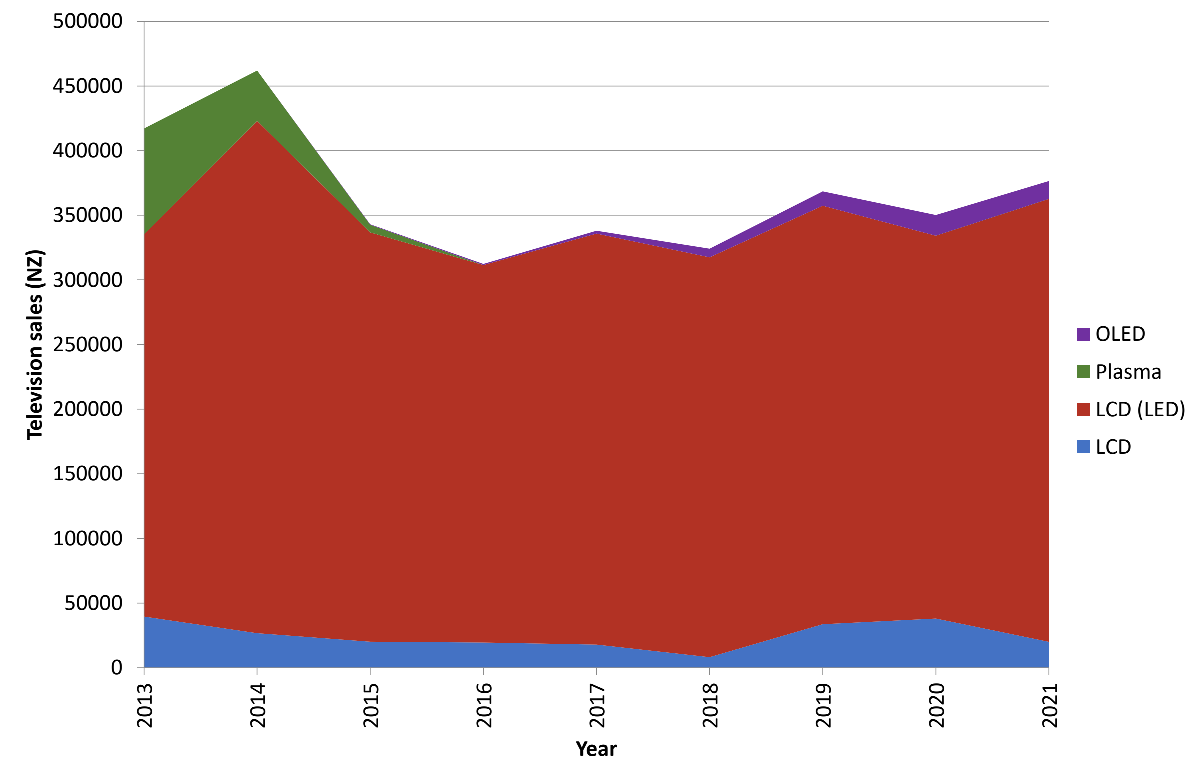

Figure 6: Sales of television by technology in New Zealand. Analysis of EECA registration data over the period. Note the shorter time frame in this figure.

The share of OLED televisions is similar in Australia and New Zealand. New Zealand appear to have recorded more LCD television sales than Australia, but this is still around 5% in 2021. Australia appeared to show a stronger upward trend in sales from 2019, but this was not evident in New Zealand. The mostly likely explanation is that many televisions were replaced in the period 2008 to 2013 (new screen technologies and the transition to digital broadcasts) and the increase in sales in 2020 may be driven by a secondary wave of replacements from that earlier period. For televisions, the pandemic did not appear to impact significantly on television sales (in contrast to computer monitors) but it did appear to increase viewing hours slightly in 2020, at least temporarily (pre-pandemic viewing hours are used for usage projections).

An important attribute of televisions that impacts on the energy consumption is the screen area. For the purposes of this analysis, screen size is shown in inches (diagonal). This is useful as many television model designations (as well as computer monitor models) are based on the screen diagonal measurement in inches and this is an industry standard measure. Screen diagonal can be converted to screen area once the aspect ratio is known. Most televisions sold in Australia and New Zealand have a 16:9 aspect ratio. Trends in screen size are shown in Figure 7.

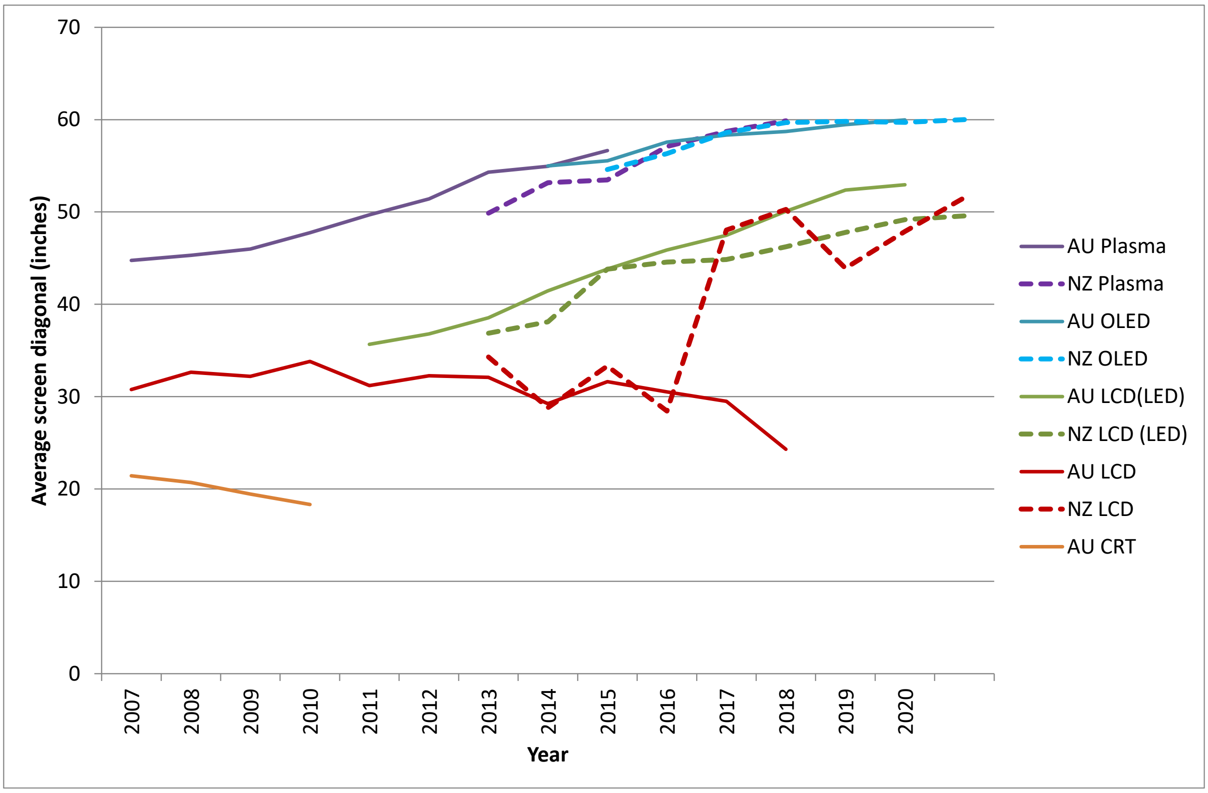

Figure 7: Trends in sales weighted screen size in Australia and NZ by screen technology

This data shows that OLED displaced plasma technology in terms of larger screen and the trends over time are consistent between the two technologies and countries (noting that OLED make up less than 5% of sales in Australia and NZ). LCD (LED) sizes and trends are also consistent between the two countries, with NZ sizes very slightly smaller than Australian sizes. It is unclear what has created the discrepancy in size for LCD screens in 2017, but this is not significant as this technology only makes up 5% of sales and is likely to decline into the future.

The next attribute to consider is the energy consumption of televisions. For this initial comparison, the Comparative Energy Consumption (CEC) as shown on the Energy Rating Label was analysed. This assumed 10 hours per day of use and 14 hours in standby mode. Initially, the overall average energy consumption per television for Australia and NZ was examined as shown in Figure 8 below.

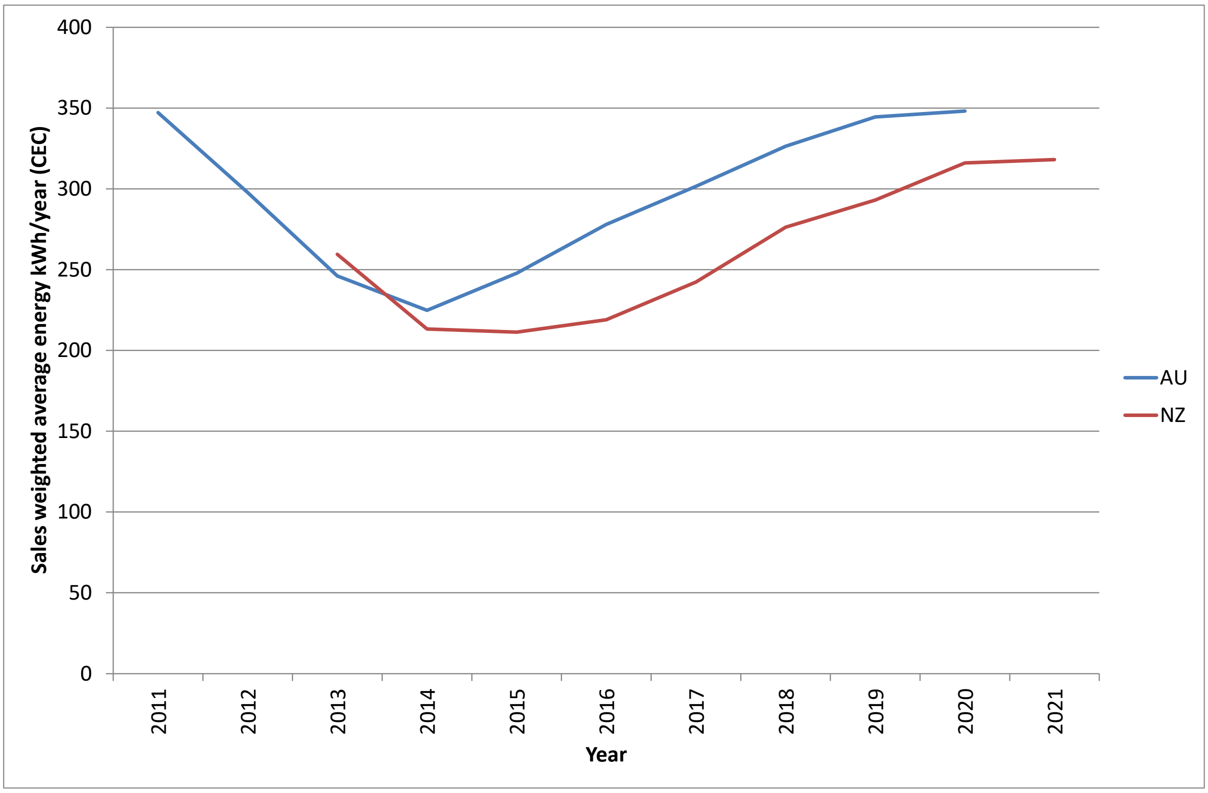

Figure 8: Sales weighted television energy consumption for Australia and New Zealand, based on analysis of GfK sales data for Australia and EECA registration data for NZ.

Data from both Australia and New Zealand showed a decrease in energy consumption until about 2014, but has shown a steady increase since that time. The energy trends in both countries are very similar, but Australia has been approximately 15% higher than New Zealand since 2015. This increase in energy, despite the presence of an existing MEPS and energy labelling program, is of concern and illustrates why updated policy action is required.

Trends in CEC by technology are shown in Figure 9 below.

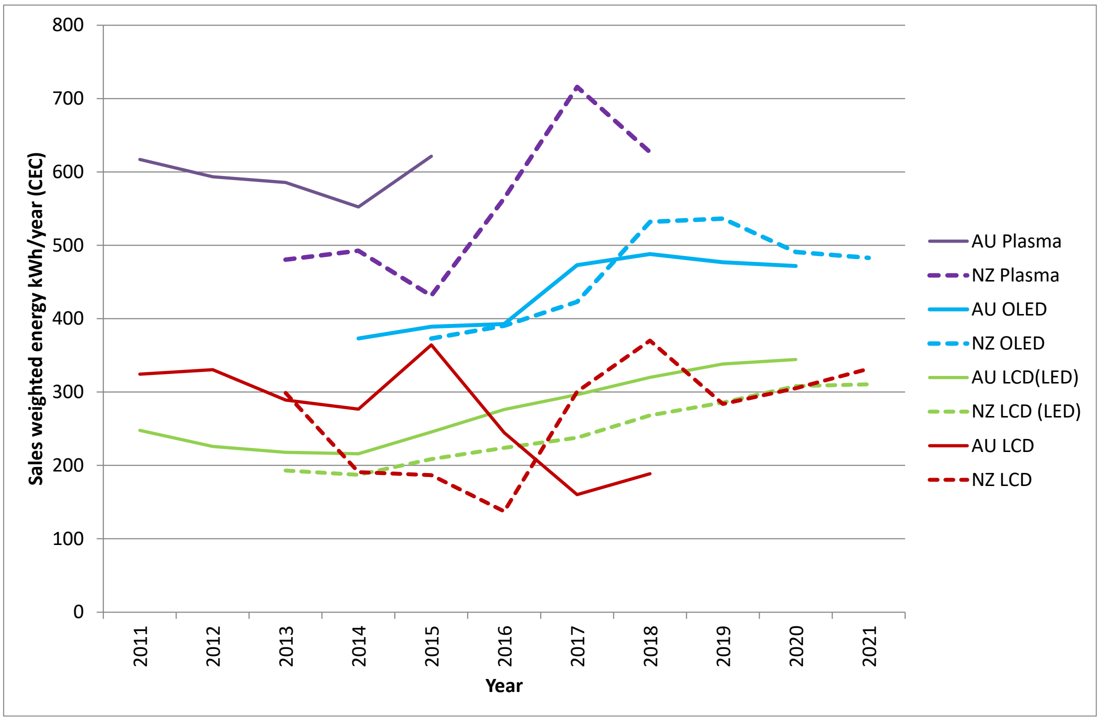

Figure 9: Sales weighted trends in energy consumption by screen technology for Australia and New Zealand

The discrepancies between Australia and New Zealand for plasma and LCD televisions are likely driven by the small number of models in each technology in later years. Neither of these technologies feature in the future projections on energy use in this CRIS. Trends in OLED energy are similar in both countries, but this technology only makes up about 5% of sales so there can be uncertainty in the data when there are small sales or few models. LED (LCD) trends closely align between the two countries, with New Zealand slightly lower and slightly behind the trend in Australia (noting that this technology makes up over 90% of all sales). The increase in energy is largely driven by the increase in screen size as shown in Figure 9 above.

Analysis of registrations has revealed that the luminance[15] of the recommended pre-set picture setting (PPS) decreased until about 2013 and then has increased since as shown in Figure 10. The average across all registration in each year have increased from a minimum of 216 cd/m² in 2013 to 311 cd/m² in 2022 which is an increase of 44%.

[15] Candela (cd) is a unit of measurement of luminous intensity. It is the amount of light radiated in a given direction. The higher the candela, the higher the intensity of the light.

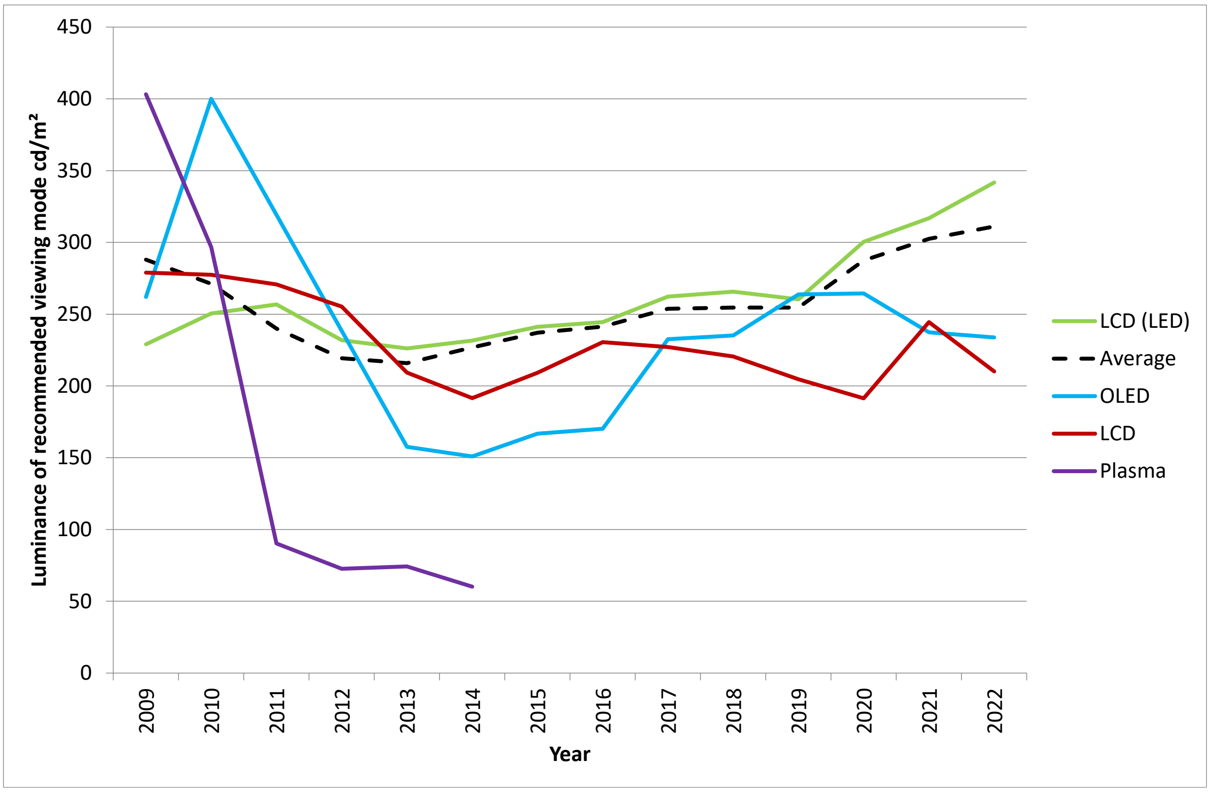

Figure 10: Average screen luminance by technology for all new registration each year. Analysis of television registration data. Note that this is not sales weighted so needs to be treated as qualitative data only.

The increasing screen luminance over time and the rapidly increasing screen size is driving up the energy consumption of televisions. This is an indication that both MEPS and energy labelling have become somewhat ineffective as tools to improve energy efficiency in recent years. This is supported by detailed market research in 2019 that showed that energy consumption and star rating is much less important for televisions than other labelled appliances and equipment[16].

The sales weighted average star rating has also been examined and is illustrated in Figure 11. This shows that the star rating stalled in 2015 and declined slowly since in both Australia and New Zealand.

[16] Market research report titled *Understanding the use of the energy rating label with TVs* commissioned by the Department of the Environment and Energy, April 2019, undertaken by Instinct and Reason.

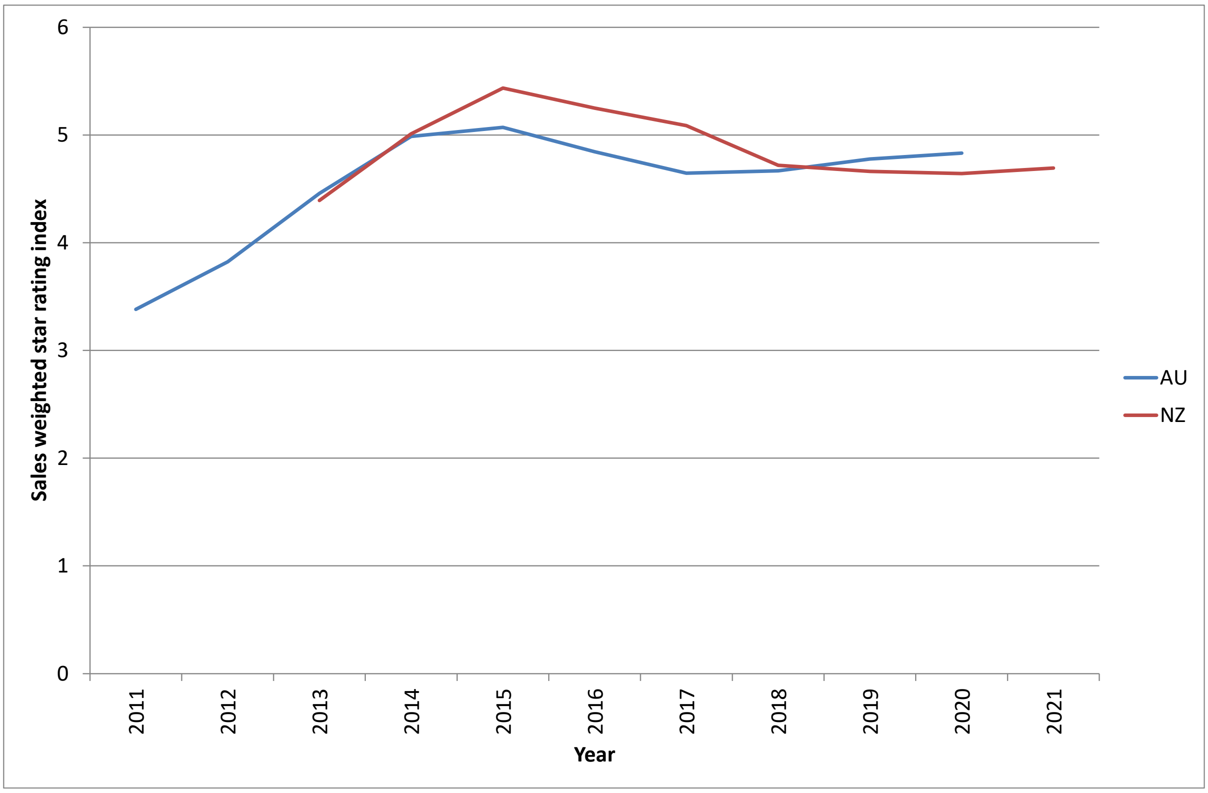

Figure 11: Sales weighted star rating index for televisions in Australia and New Zealand

The relatively small decline in the star rating index (SRI) does not reflect the increase in energy consumption that is evident in Figure 12. This is because the efficiency metric used for televisions is based on a simple kWh per unit of screen area[17]. The current distribution of recently registered products is that lower star rating bins are largely empty, meaning that most products rate 5 or more stars. This means the label is now less effective.

[17] The EU energy labelling and MEPS reference curves (and the previous Energy Star equations to V8) use a so-called progressive efficiency metric for electronic screens, where the screen technology has to effectively become more efficient as screen sizes increase in order to meet the same threshold.

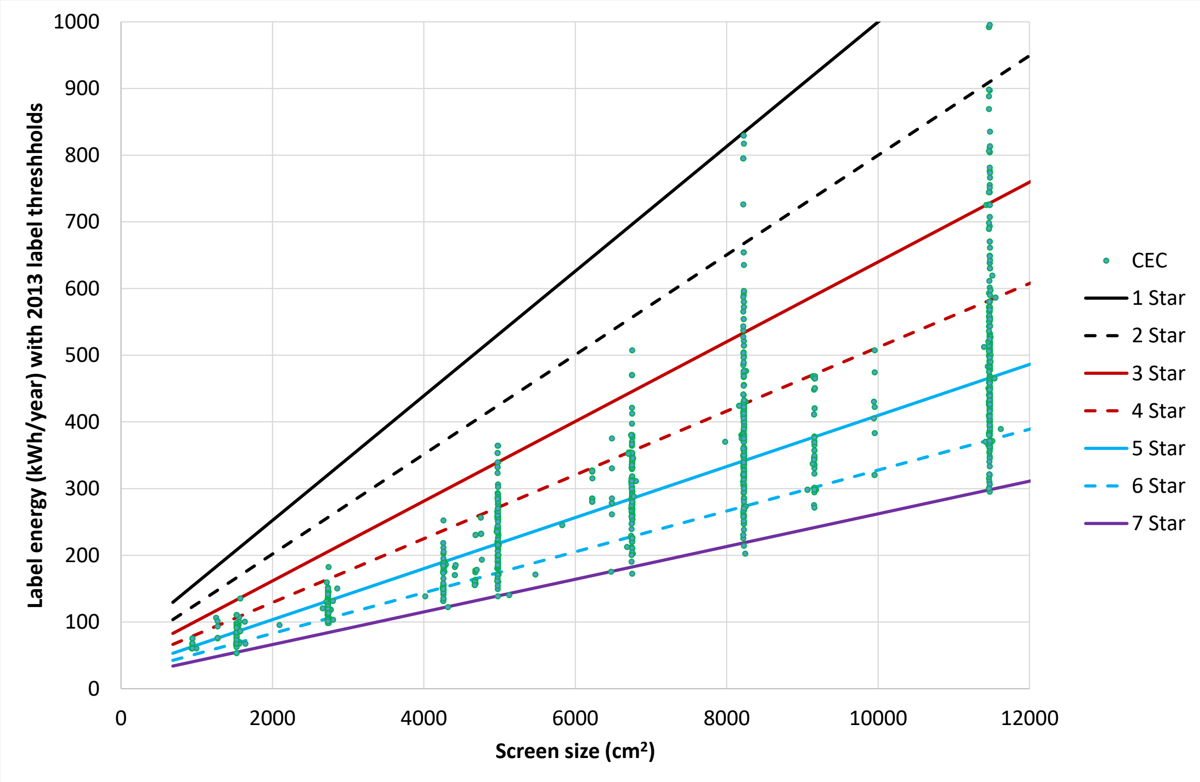

Figure 12: Screen size and energy consumption of televisions registered in 2020 to 2022

Automatic Brightness Control

Under the EU regulations for electronic displays, an energy reduction of 10% is applied to the measured energy consumption if the model can demonstrate that it is capable of meeting the power reduction levels specified for each of the nominated room illuminance levels when Automatic Brightness Control is activated.

The European television database lists 10,331 models as at September 2022, of which some 1,804 (17%) have an ABC control that meets the EU policy requirements. The share of models that have ABC in some shape or form is likely to be larger than this, but for the purposes of this analysis to assess the policy impacts, it was assumed that the same proportion of televisions in Australia and New Zealand will have a qualifying ABC control (17%). For modelling purposes, it is assumed that qualifying ABC controls will save at least as much energy in normal use as the 10% allowance, so no explicit adjustment is necessary for energy modelling in this CRIS.

Baseline projections for modelling televisions – business as usual case

As set out in the previous analysis, there is a change in the mix of technologies and a change in product size over time. To establish the baseline case where there is no change to the current policy settings, the market was split into four size ranges and each of these tracked historically to date and then projected into the future. The advantage of doing this is that energy and size parameters are more stable within a size range cohort and the market share of each size range into the future can visualised and adjusted based on the progression of historical data.

Before selecting size ranges for analysis, television sales data was examined to identify the most common nominal size configurations. These were:

- 19 inch
- 24 inch
- 32 inch
- 40 inch
- 43 inch
- 49 inch
- 50 inch
- 55 inch (largest seller)
- 65 inch
- 75 inch and larger sizes.

When selecting nominal size break points, it is critical to avoid common sizes so that all products of the same nominal size end up in the same size grouping. Note that nominal diagonals (in inches) are usually up to 0.5 inches larger than the actual diagonal (as contained in the product registration). On the basis of this analysis, the size ranges for televisions were selected as follows:

- Less than 35 inch screen diagonal (nominal area < 3377 cm^2)
- 35 inches ≤ screen diagonal < 52 inches (3377 cm^2 ≤ nominal area < 7454.3 cm^2)
- 52 inches ≤ screen diagonal < 72 inches (7454.3 cm^2 ≤ nominal area < 14291 cm^2)
- Greater than or equal to screen diagonal 72 inches (nominal area ≥ 14291 cm^2).

Over time, the sales weighted average area of these cohorts is relatively stable. The key parameter of interest for investigating the impact of the policies under consideration is the on-mode power, as this is the parameter specified in the EU regulation for electronic displays. This historical on-mode power for each size cohort in Australia and New Zealand and projected values to 2035 are shown in the following figures for each of the size ranges and each of the resolution levels covered by the EU regulations. The on-mode power has varied from -3% per annum to +3% per annum, depending on the size cohort, technology and country and year range. Given that most of the program impacts of the initial labelling and MEPS introduction have now settled, an assumed improvement rate of -0.5% per annum has been applied over the projection period as the business as usual case (without changes to current program settings).

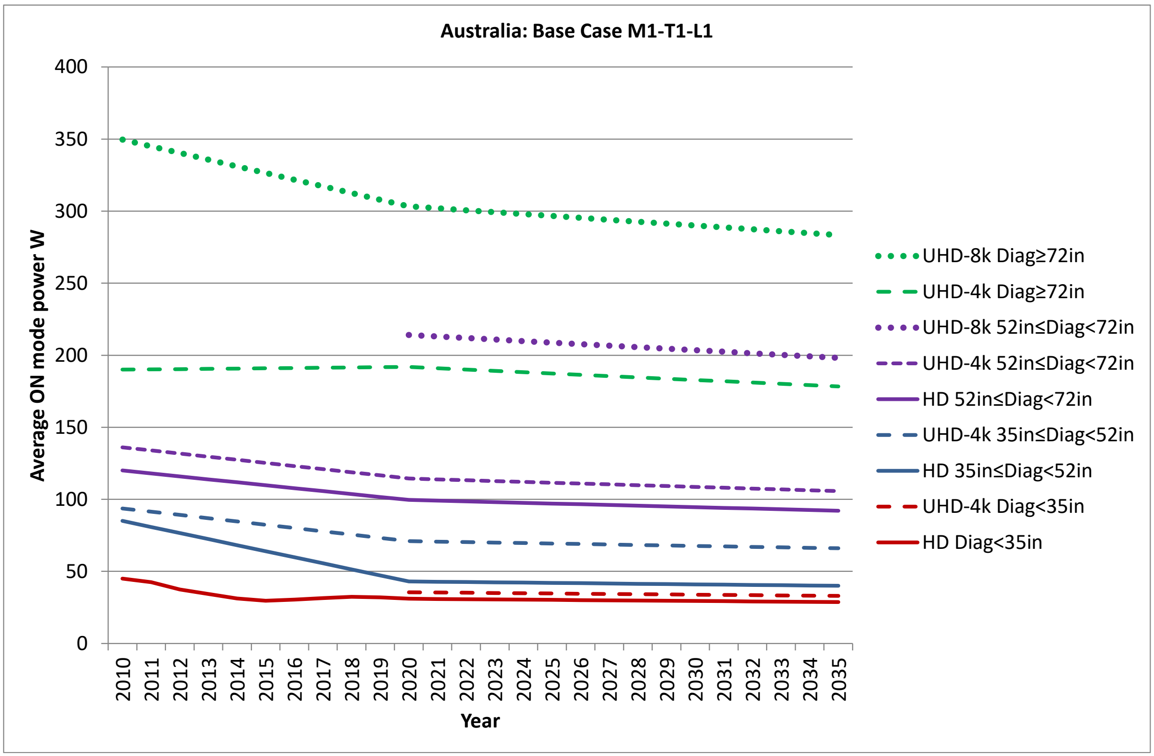

Figure 13: Historical and projected on-mode power for televisions by size range and resolution, Australia. Sales weighted data to 2020, projections at -0.5% per annum to 2035. Average power within each size range will be increasing as the share of higher resolution models increases over time.

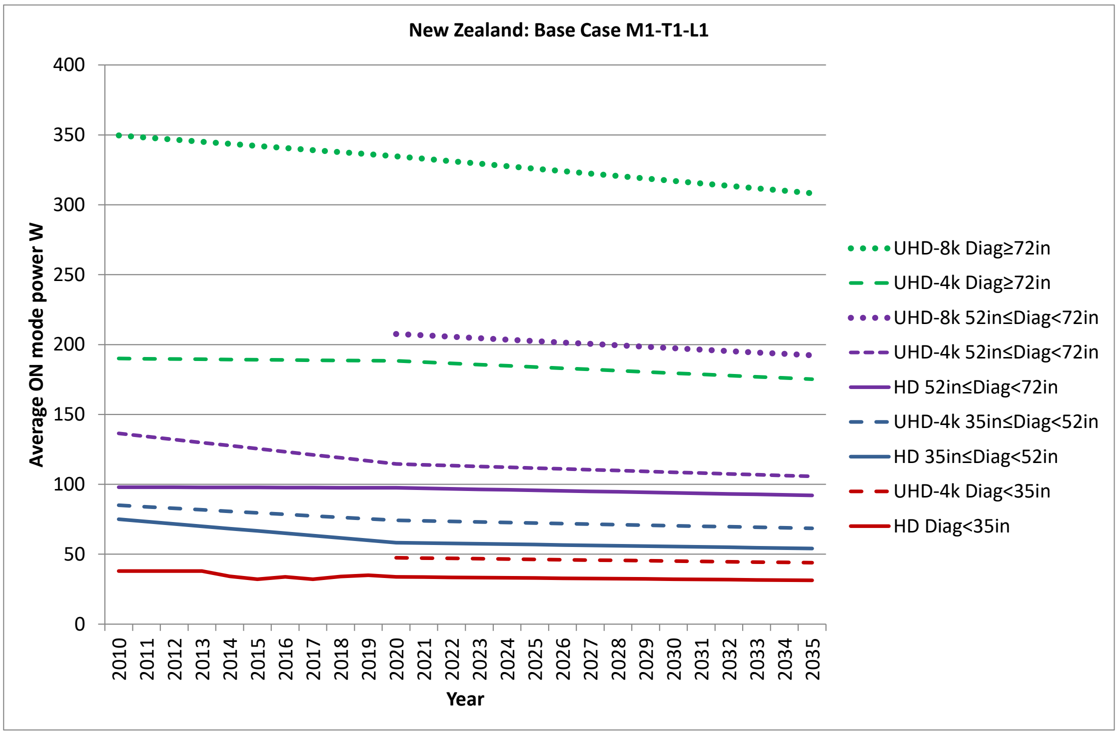

Figure 14: Historical and projected on-mode power for televisions by size range and resolution, New Zealand. Sales weighted data to 2021, projections at -0.5% per annum to 2035. Average power within each size range will be increasing as the share of higher resolution models increases over time.

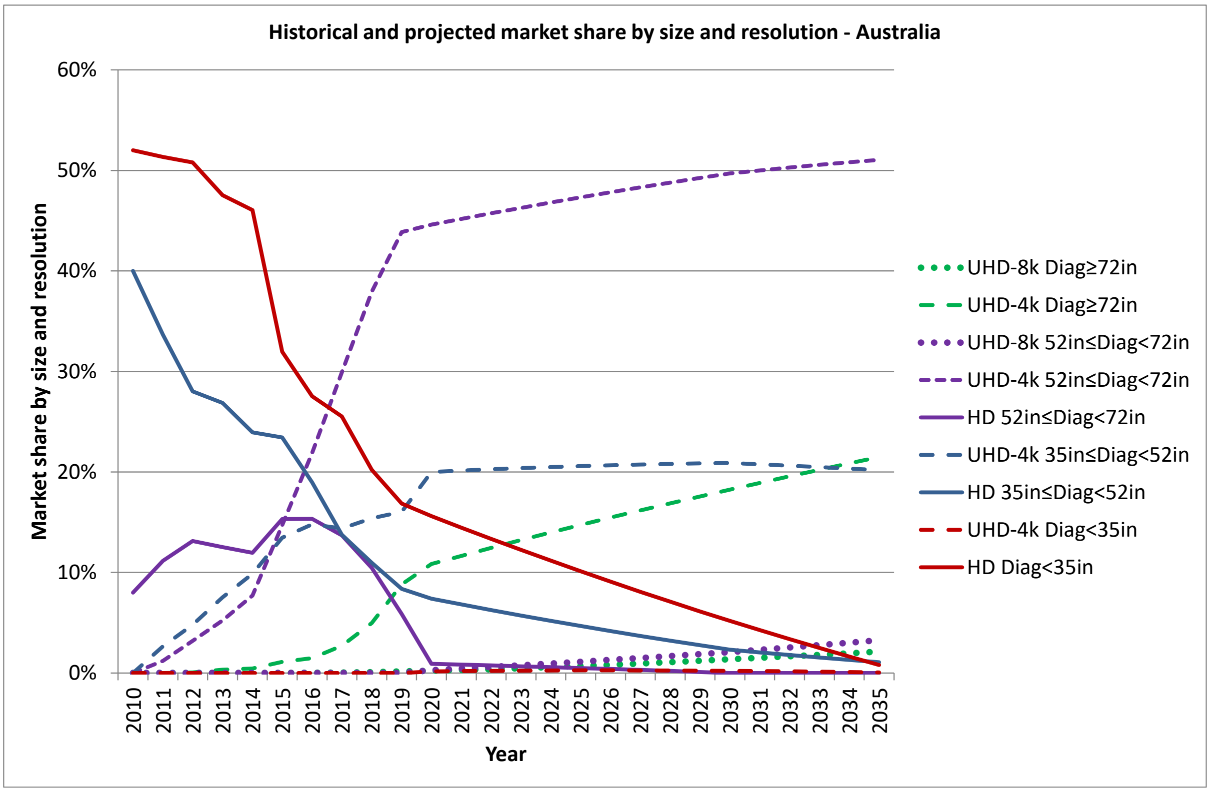

Figure 15: Historical and projected market share for televisions by size range and resolution, Australia (sales weighted data to 2020)

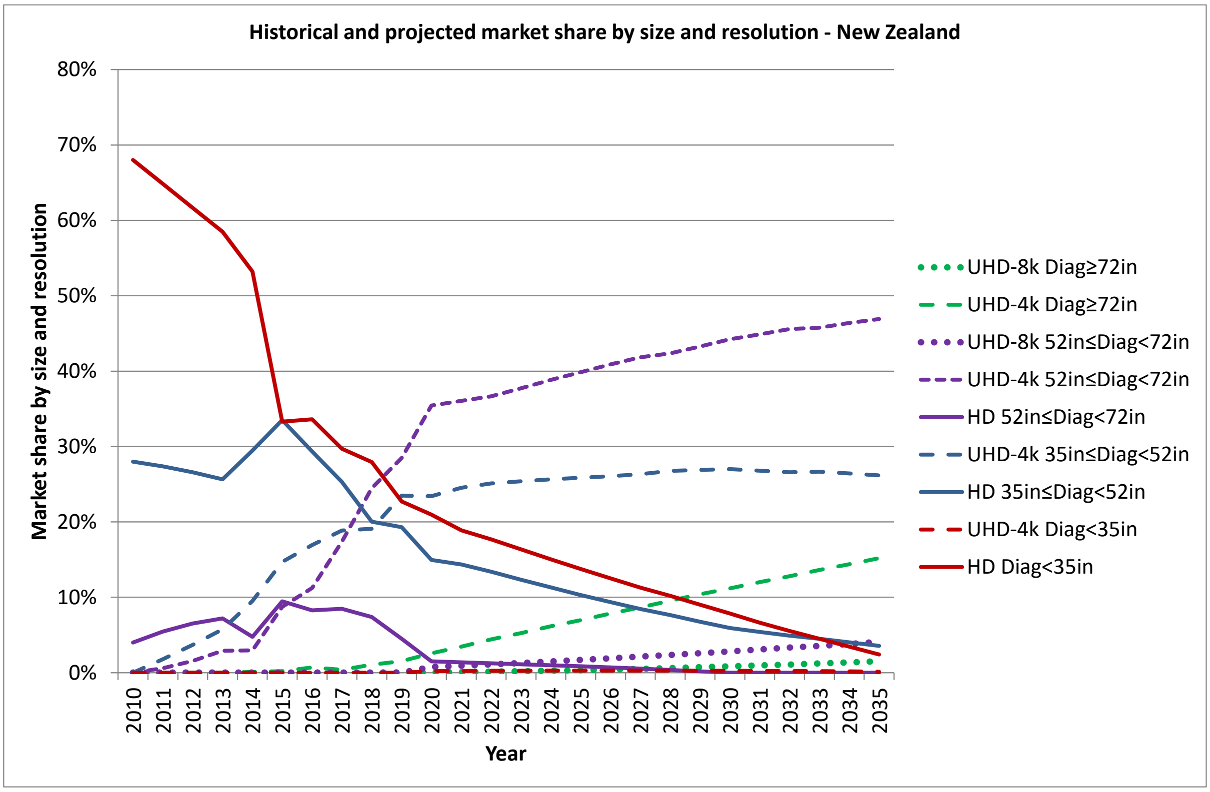

Figure 16: Historical and projected market share for televisions by size range and resolution, New Zealand (sales weighted data to 2021)

Impact assessment of policy options for televisions

One of the core policy options under consideration is the adoption of the European Commission Ecodesign Regulation for electronic displays which has on-mode MEPS requirements for televisions and computer monitors. The regulation also defines maximum permitted power levels for various low power modes, such as off-mode, standby mode and networked standby mode, with adders for specific functions and an overall cap on the permitted power in each mode. Digital signage displays have maximum permitted power levels for off-mode, standby and networked standby modes but no MEPS for on-mode.

In order to assess the impact of the EU 2021 and EU 2023 Ecodesign levels on televisions currently on the market in Australia and New Zealand, the key performance parameters as defined in the EU regulation was determined for each model with a current registration as follows:

- Screen resolution and EU electronic display resolution category: HD, UHD-4k, UHD-8k
- The calculated Ecodesign *EEI* value for the model based on it measured on-mode power
- Determination of the applicable MEPS level for EU 2021 and EU 2023.
- The maximum permitted power consumption for EU 2021 and EU 2023 in watts
- An assessment of whether the model currently passes EU 2021 and EU 2023 MEPS
- If the product does not meet the EU 2021 or EU 2023 MEPS requirements, the power target that the product would need to achieve in order to have a small margin below MEPS (nominal 5%)
- The EU labelling EEI_{label} index for the product and the relevant EU label grade (refer Commission Regulation (EU) 2019/2021 of 1 October 2019 laying down Ecodesign requirements for electronic displays)
- The EU labelling EEI_{label} index after the impact of EU 2021 and EU 2023 MEPS where the power level has been adjusted to meet the EU 2021/2023 MEPS with a 5% margin.

Three separate data sources were used to assess the impact of the EU Ecodesign policies:

- Analysis of the registration database for televisions
- Analysis of sales data for Australia (GfK) from 2007 to 2020
- Analysis of sales data for New Zealand (EECA) from 2013 to 2021.

Table 2 summarises the characteristics for each of the key product size categories and resolution levels defined in the Ecodesign regulations. Of the 1,582 television models registered after 31 December 2019, 61% of registrations pass the EU 2021 MEPS requirements and 26% of registrations pass the EU 2023 requirements.

All cohorts with some registrations had some models that could meet the EU 2023 requirements except for UHD-8k, where no current models appear to be able to comply. This will impact on 30 models in the 52-72 inches diagonal size category and 45 models with a diagonal measurement bigger than 72 inches. These models represented 0.5% of sales in Australia in in 2020 and 0.8% of sales in New Zealand in 2021. While the apparent potential elimination of current UHD-8k models is of some concern, the EU EPREL database lists at least 151 models that are classified as 8k and 10 of these pass the EU 2023 requirements as at September 2022.

The estimated power impact of the Ecodesign regulations is set out in Table 3. The impact varies to some extent when comparing the models registered with sales weighted data from Australia and New Zealand. The last four rows illustrate the values for each country selected for energy modelling.

Table 2: Summary of EU Ecodesign MEPS impact on televisions models in Australia and New Zealand

Cohort – size/resolution → Parameter ↓	Diag<35in HD	Diag<35in UHD-4k	Diag<35in UHD-8k	35in≤Diag <52in HD	35in≤Diag <52in UHD-4k	35in≤Diag <52in UHD-8k	52in≤Diag <72in HD	52in≤Diag <72in UHD-4k	52in≤Diag <72in UHD-8k	Diag≥ 72in HD	Diag≥72in UHD-4k	Diag≥72in UHD-8k	Total
Models reg after 2019	165	8	0	121	285	0	10	642	30	1	275	45	1582
Share reg models	10%	1%	0%	8%	18%	0%	1%	41%	2%	0%	17%	3%	100%
Models pass EU 2021	113	7	0	89	170	0	3	439	0	1	148	0	970
Models pass EU 2023	48	4	0	47	75	0	1	191	0	0	46	0	412
Models pass EU 2021	68%	88%	#N/A	74%	60%	#N/A	30%	68%	#N/A	100%	54%	#N/A	61%
Models pass EU 2023	29%	50%	None reg	39%	26%	None reg	10%	30%	0%	0%	17%	0%	26%
OLED models	0	0	0	0	0	0	0	80	0	0	21	7	108
OLED pass EU 2021	None reg	None reg	#N/A	None reg	None reg	#N/A	None reg	48	#N/A	None reg	18	#N/A	66
OLED pass EU 2023	None reg	None reg	None reg	None reg	None reg	None reg	None reg	11	None reg	None reg	3	0	14
AU sales 2020	15.8%	0.0%	0.0%	10.2%	17.2%	0.0%	0.1%	45.5%	0.2%	0.0%	10.9%	0.2%	100%
Av SW size AU cm^2	2565	0	0	4730	6140	0	8340	9973	11414	0	16077	16340	8290
Av SW size NZ cm^2	2536	2743	0	4949	5824	0	9172	9720	11404	0	16367	16658	6918

Table notes: The following cohorts do not currently exist and are likely to be rare in the future: Diag<35in UHD-8k, 35in≤Diag<52in UHD-8k, Diag≥72in HD. Registrations approved after 31 Dec 2019 up to 31 August 2022. NZ sales data to 2021 was used in the modelling but has not been included in this table for confidentiality reasons.

#N/A indicates that MEPS for this cohort is not applicable (UHD-8k for EU 2021 MEPS).

None reg means that no models were registered in that cohort over the specified period so the impact of MEPS on model availability could not be established. OLED model data is included in total data above.

Table 3: Summary of EU Ecodesign MEPS power impact on televisions in Australia and New Zealand

Cohort – size/resolution → Parameter ↓	Diag<35in HD	Diag<35in UHD-4k	Diag<35in UHD-8k	35in≤Diag <52in HD	35in≤Diag <52in UHD-4k	35in≤Diag <52in UHD-8k	52in≤Diag <72in HD	52in≤Diag <72in UHD-4k	52in≤Diag <72in UHD-8k	Diag≥72in HD	Diag≥72in UHD-4k	Diag≥72in UHD-8k
Power reg after 2019 W	26.0	30.0	None reg	46.8	73.9	None reg	99.6	114.8	216.6	118.3	191.9	303.3
Power after EU 2021 W	24.6	28.7	None reg	43.9	68.5	None reg	85.6	104.8	216.6	118.3	168.0	303.3
Power after EU 2023 W	22.0	26.4	None reg	39.7	59.6	None reg	73.3	92.1	102.1	111.5	143.4	143.9
Reg Power impact EU 2021	-5.4%	-4.2%	None reg	-6.1%	-7.3%	None reg	-14.1%	-8.7%	0.0%	0.0%	-12.4%	0.0%
Reg Power impact EU 2023	-15.4%	-11.8%	None reg	-15.2%	-19.4%	None reg	-26.4%	-19.8%	-52.9%	-5.8%	-25.3%	-52.5%
SW impact AU EU 2021	-8.5%	-20.7%	No sales	-1.3%	-4.8%	No sales	-4.4%	-7.2%	0.0%	No sales	-8.2%	0.0%
SW impact AU EU 2023	-19.1%	-35.5%	No sales	-8.6%	-17.6%	No sales	-20.4%	-17.8%	-59.7%	No sales	-19.8%	-59.4%
SW impact NZ EU 2021	-14.3%	-20.7%	No sales	-13.5%	-5.9%	No sales	-21.9%	-8.4%	0.0%	No sales	-11.9%	0.0%
SW impact NZ EU 2023	-26.8%	-35.5%	No sales	-26.7%	-20.3%	No sales	-35.1%	-20.3%	-49.0%	No sales	-25.6%	-57.5%
AU impact for EU 2021	-8%	-20%	No model	-2%	-5%	No model	-6%	-8%	0%	No model	-9%	0%
AU impact for EU 2023	-19%	-35%	No model	-10%	-18%	No model	-20%	-18%	-60%	No model	-20%	-58%
NZ impact for EU 2021	-14%	-20%	No model	-12%	-6%	No model	-21%	-8%	0%	No model	-12%	0%
NZ impact for EU 2023	-25%	-35%	No model	-24%	-20%	No model	-35%	-20%	-50%	No model	-25%	-55%

Table notes: Registrations approved after 31 Dec 2019 up to 31 August 2022.

None reg means that no models were registered in that cohort over the specified period so the impact of MEPS on-model availability could not be established.

No sales indicates that no sales were recorded in Australia and/or New Zealand (as applicable) in the last year of available data.

Assumed energy impact for modelling in Australia and New Zealand (last four rows) has been developed from sales weighted data over past 3 years and from registration data activity, which reflects the mix of products on sale in each country.

The relative impact of EU 2021 MEPS for each of main cohorts with product sales is illustrated in Figure 17.

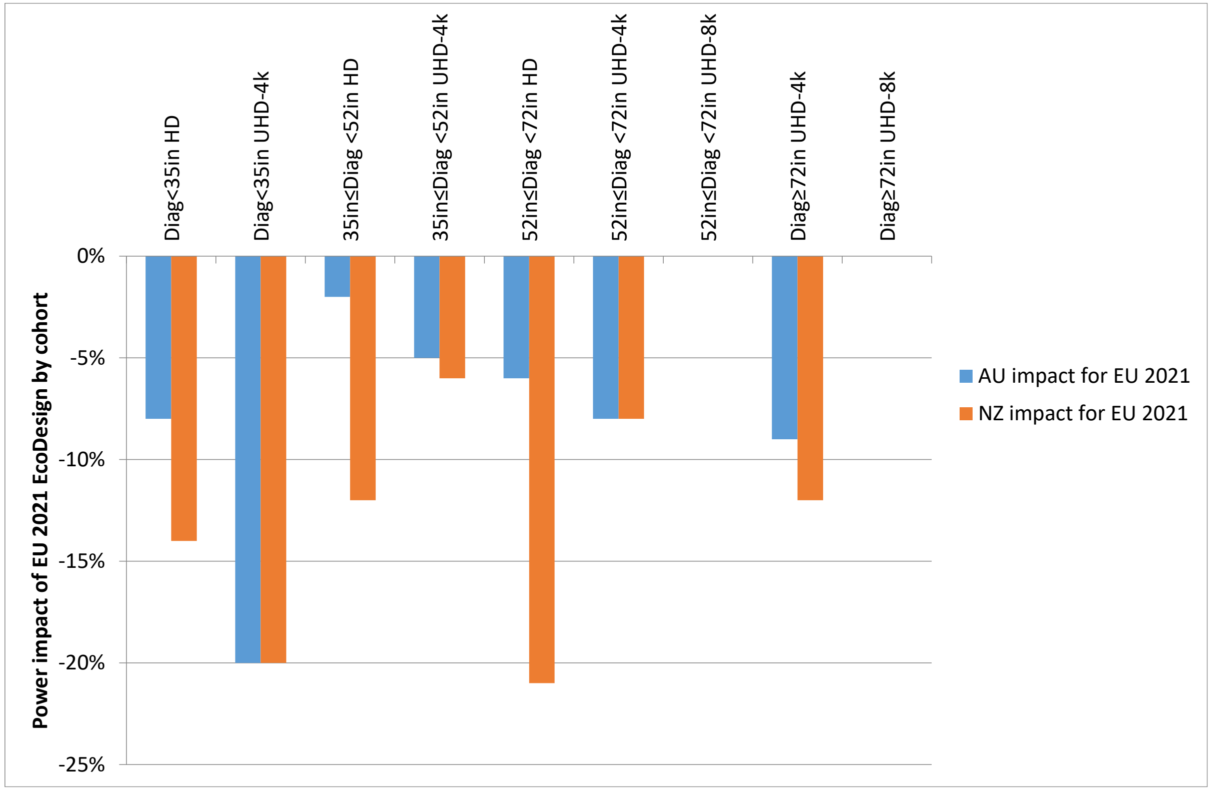

Figure 17: Expected change in on-mode power of current televisions from EU 2021 MEPS. Impacts are as set out in

Table 3. No MEPS levels are defined for UHD-8k products in EU 2021.

The relative impact of EU 2023 MEPS for each of main cohorts with product sales is illustrated in Figure 18.

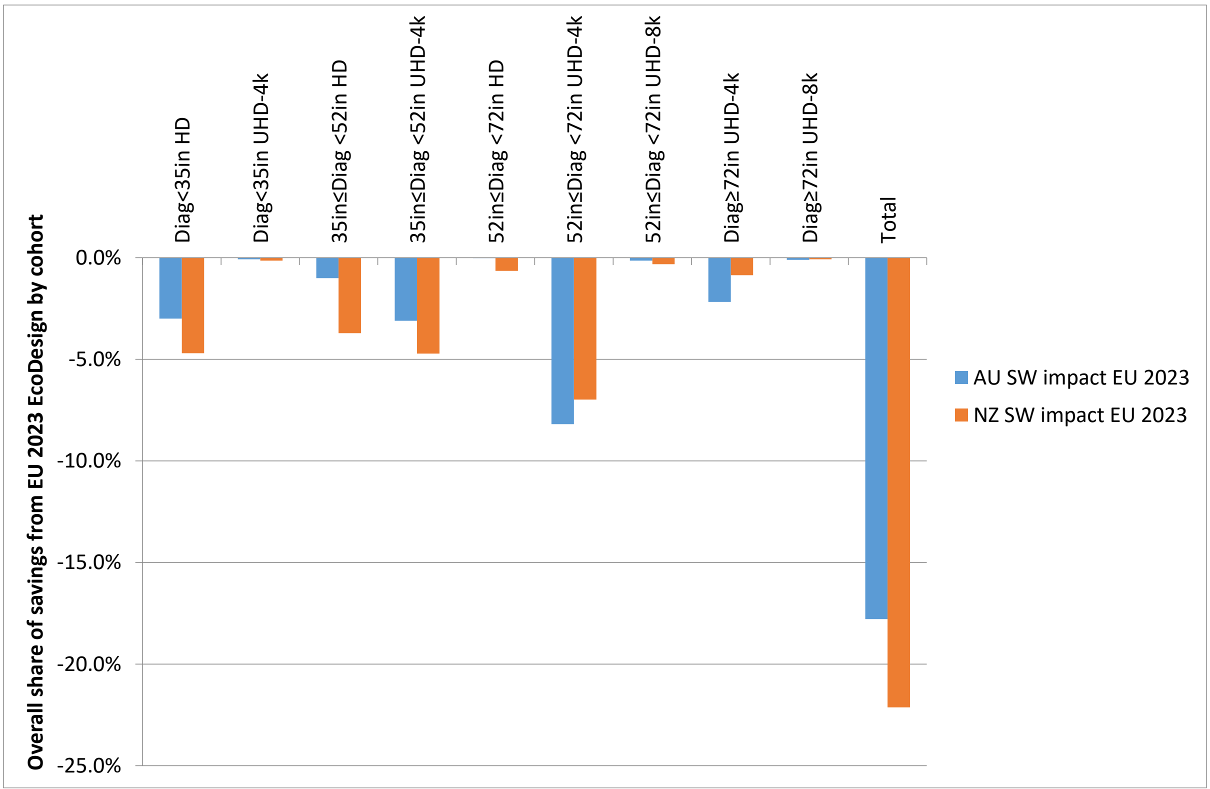

Figure 18: Expected overall energy savings for televisions from EU 2023 MEPS

Overall savings from EU 2023 MEPS are expected to be 18% for Australia and 22% for New Zealand. Overall savings are higher in larger sizes in Australia (where the sales share is higher) and lower in larger sizes in New Zealand (where sales share is lower).

Other impacts from the EU Ecodesign requirements are set out below.

EU Low Power Modes - televisions

The Ecodesign regulation for electronic displays sets limits for low power modes (see Table 2 of Commission Regulation (EU) 2019/2021 of 1 October 2019 laying down Ecodesign requirements for electronic displays). Table 4: EU Ecodesign power demand limits for other than on-mode, in watts

Parameter	Off-mode	Standby mode	Networked standby mode
Limit for mode	0.3	0.5	2.0
Max limit with all adders	0.3	2.2	7.7

For standby and network standby modes, the mode limit can be increased by defined adders for specific functions such as status display, deactivation using room presence detection, touch functionality (if usable for activation) and High Network Availability (where applicable). The maximum power in the mode cannot exceed the value specified above, irrespective of the number and type of adders that are applied.

These power limits on low power modes are not particularly stringent and most products on the market in Australia and New Zealand are likely to be able to comfortably meet these requirements (or they could easily modify their products so that they do comply). While the introduction of these low power mode limits is recommended as a safeguard, the ongoing impact of these limits on current products will be small and are assumed to be close to zero in terms of modelling future energy impacts.

One issue is that the EU requirements do not adequately cover some of the newer smart television features such as voice activation (smart wake), which consumes significant power in some models. Directly addressing the power consumed in this mode may need to be included in the overall approach.

Labelling assumptions for cost benefit analysis modelling

Labelling impacts on cost benefit ratios are typically a small proportion of the impacts from increased stringency of MEPS levels. In this CRIS, labelling impacts have been included as part of the overall cost benefit analysis and haven't been modelled separately from MEPS.

In terms of modelled impacts, previous experience in Australia and New Zealand has shown that, after the introduction of stringent MEPS levels, the expected rate of improvement in the short term will be low, because manufacturers are focusing on meeting the new MEPS requirements for all of their products and do not have the resources to look at optimising incremental energy improvements on an opportunistic basis in the short term.

For televisions, the assumptions for modelling are that the new label regrade will result in an ongoing energy improvement rate of 1% per annum as a result of the label regrade. This is somewhat lower than might be expected for other products (based on international data) but market research has shown that television labels are likely to be less effective than for other products, so this baseline impact has been somewhat downgraded. The rate of improvement is expected to fall to 0.5% for the first four years after the introduction of EU 2023 MEPS, which will impact a significant number of products.

Baseline input data – computer monitors

The market for computer monitors is somewhat simpler than for televisions, in that most monitors now use LCD (LED) technology with just a small share using LCD (with fluorescent backlight). LCD monitors appear to make up about 30% of total registrations and comprise about 20% of sales in both Australia and New Zealand. There are almost no other technologies in use. To date there have been just 6 OLED monitor registrations out of a total of 2700 registrations approved as of early September 2022, and these 6 registrations have negligible sales. In Europe, OLED monitors make up less than 0.4% of registrations. For the purposes of modelling future energy consumption only LCD technologies are being analysed. In addition, the EU regulations do not differentiate by display technology. The one exception is MicroLEDs, which are treated in the EU Regulations as UHD-8k for the purposes of determining MEPS. This technology is not yet available in Australia/New Zealand and there are virtually no models in Europe at this stage.

It is useful to examine the sales of computer monitors and computers in Australia and NZ to understand the drivers of monitor sales.

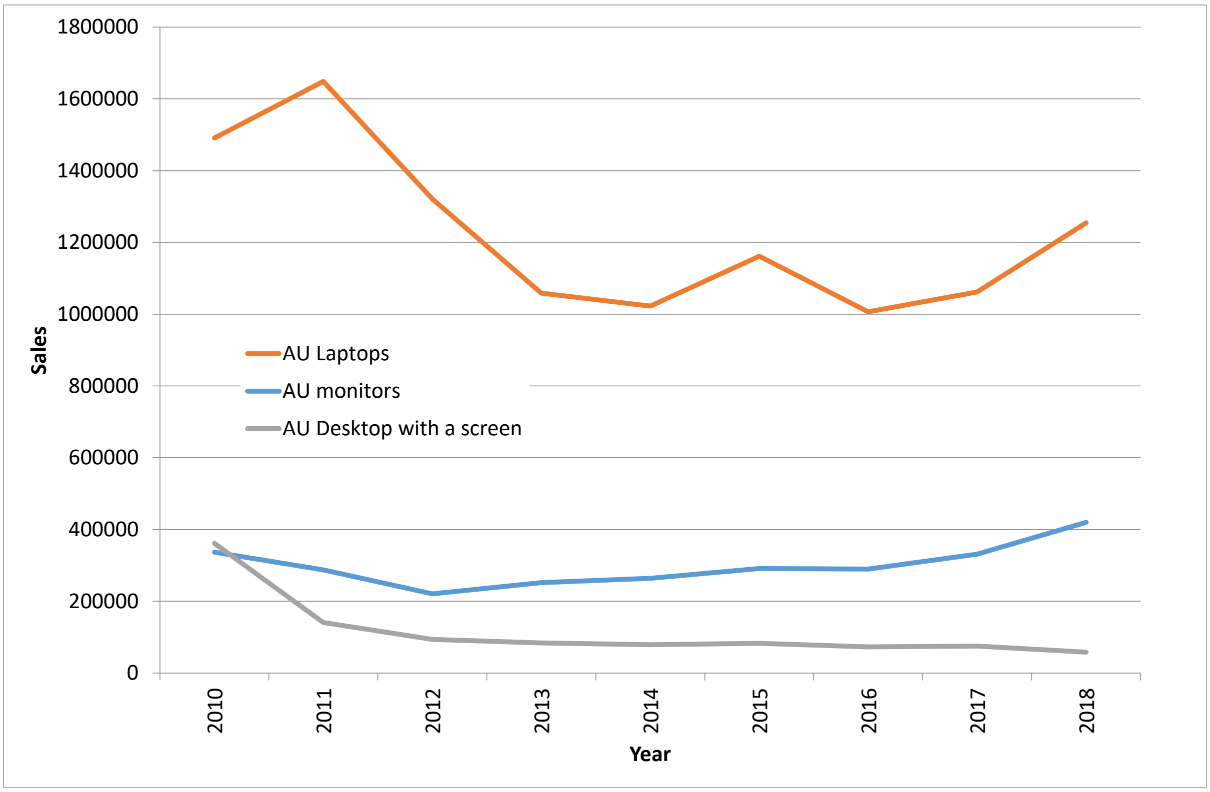

Figure 19: Overview of computer and computer monitor sales in Australia

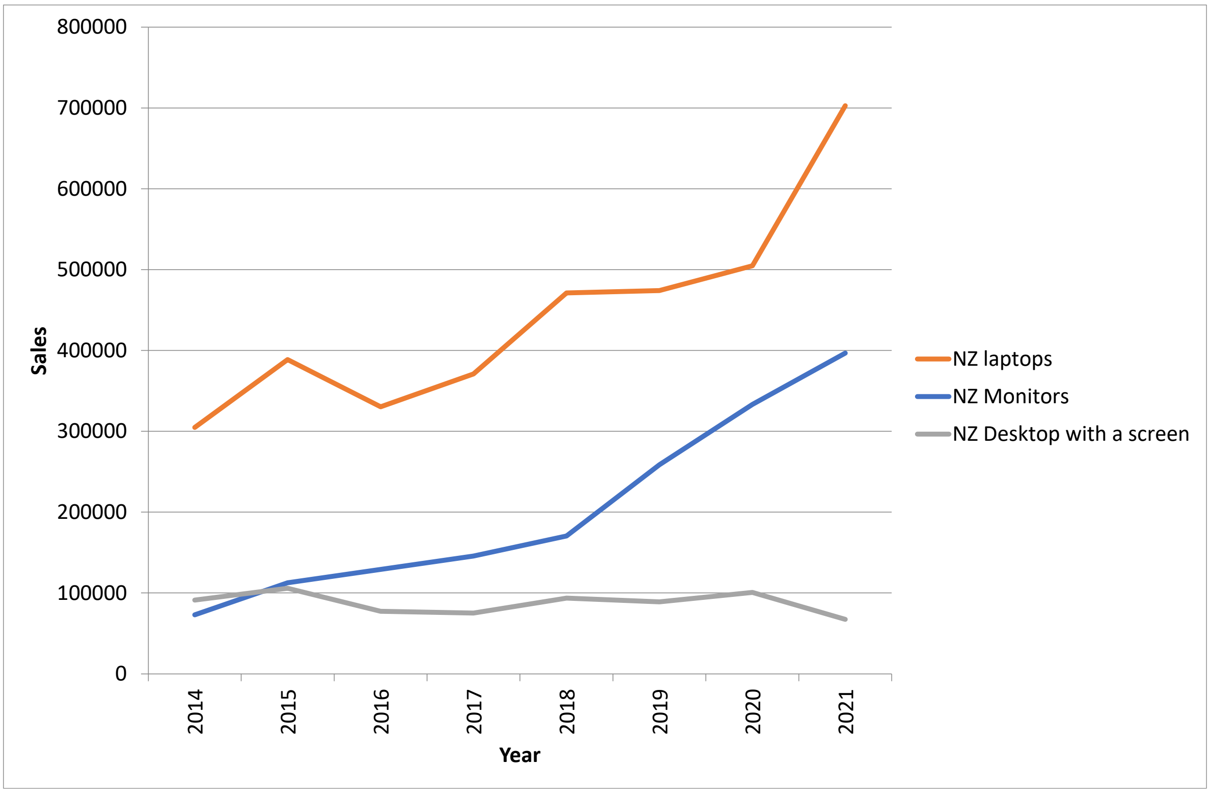

Figure 20: Overview of computer and computer monitor sales in New Zealand

The first important observation is that desktop computer sales are declining in both Australia and NZ, although the relative fall in Australia is probably larger (this may be due to incomplete market data in Australia). Around 10 years ago, it appeared that desktop computer sales and monitor sales were fairly similar. Since then, computer monitor sales have increased while desktop sales have decreased, suggesting that many monitors are now used with laptops. This is particularly noticeable during the pandemic, when monitor sales appeared to increase markedly in Australia (and less so in NZ) as shown in Figure 21.

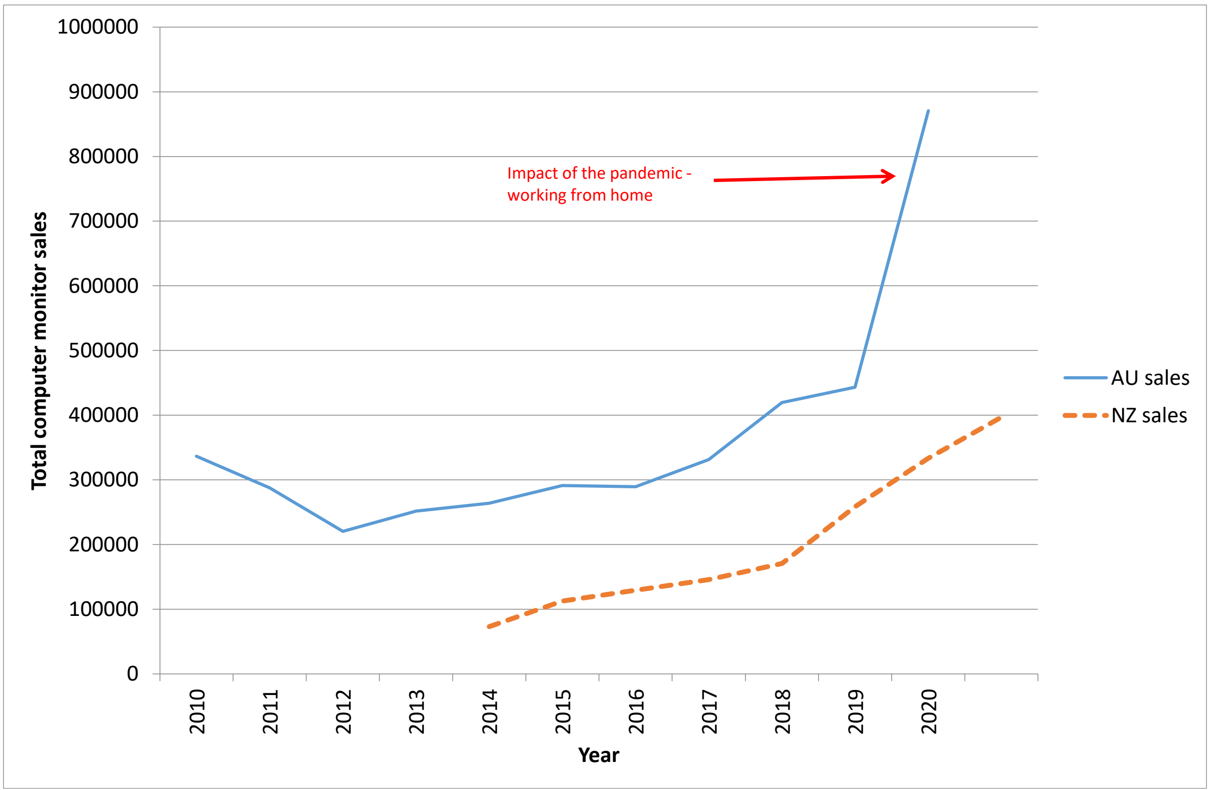

Figure 21: Total computer monitor sales in Australia and New Zealand

The number of laptops, desktop computers and monitors sold per head of population appears to be somewhat larger in NZ than Australia (unlike televisions, where the ratio of sales in Australia is about 5 to 6 times that in NZ, as expected from the population difference). This may be due to incomplete data collected by GfK, but the source of the difference is not known. This is explored in more detailed in the section on stock modelling. The second important observation is that laptop use for work, especially when working remotely from the office, is now a key driver of computer monitor sales.

Like televisions, computer monitors have been increasing in size over time, but the change is much slower than for televisions, as illustrated in Figure 22.

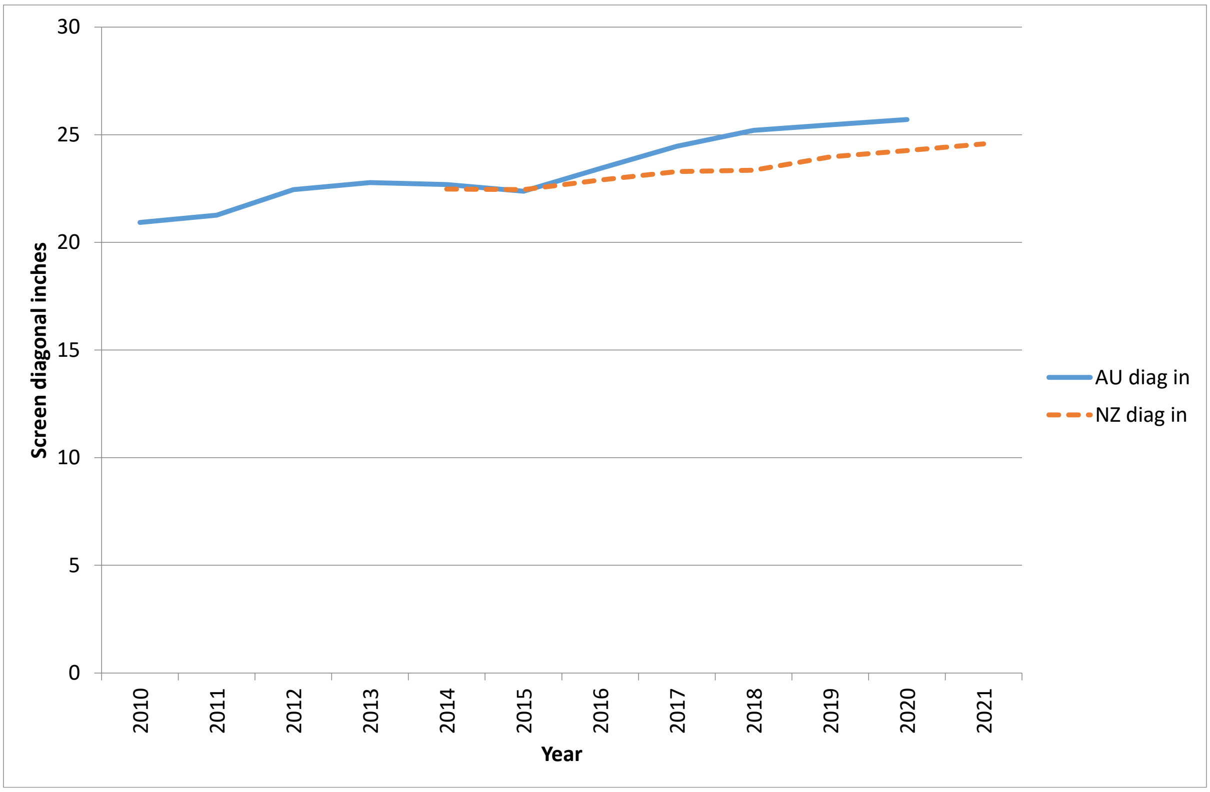

Figure 22: Sales weighted size of new monitors sold in Australia and New Zealand

The sales distribution in 2010, 2015 and 2020 is illustrated in Figure 23.

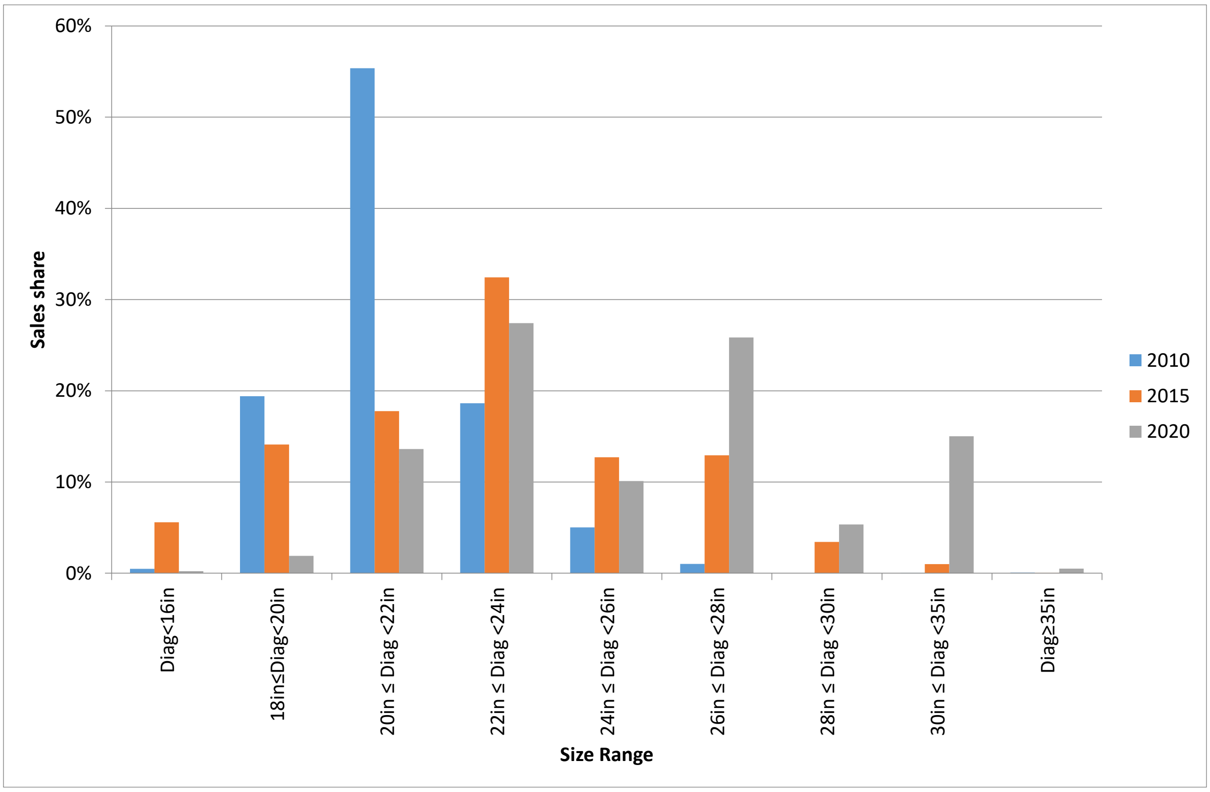

Figure 23: Sales distribution by size for computer monitors in Australia, 2010, 2015 and 2020

Analysis of sales weighted data has shown that the size energy characteristics of LCD versus LCD (LED) monitors are generally very similar, so it is not necessary to undertake a separate analysis of these two technologies for computer monitors.

Examining the sales weighted energy reveals some interesting trends as shown in Figure 24.

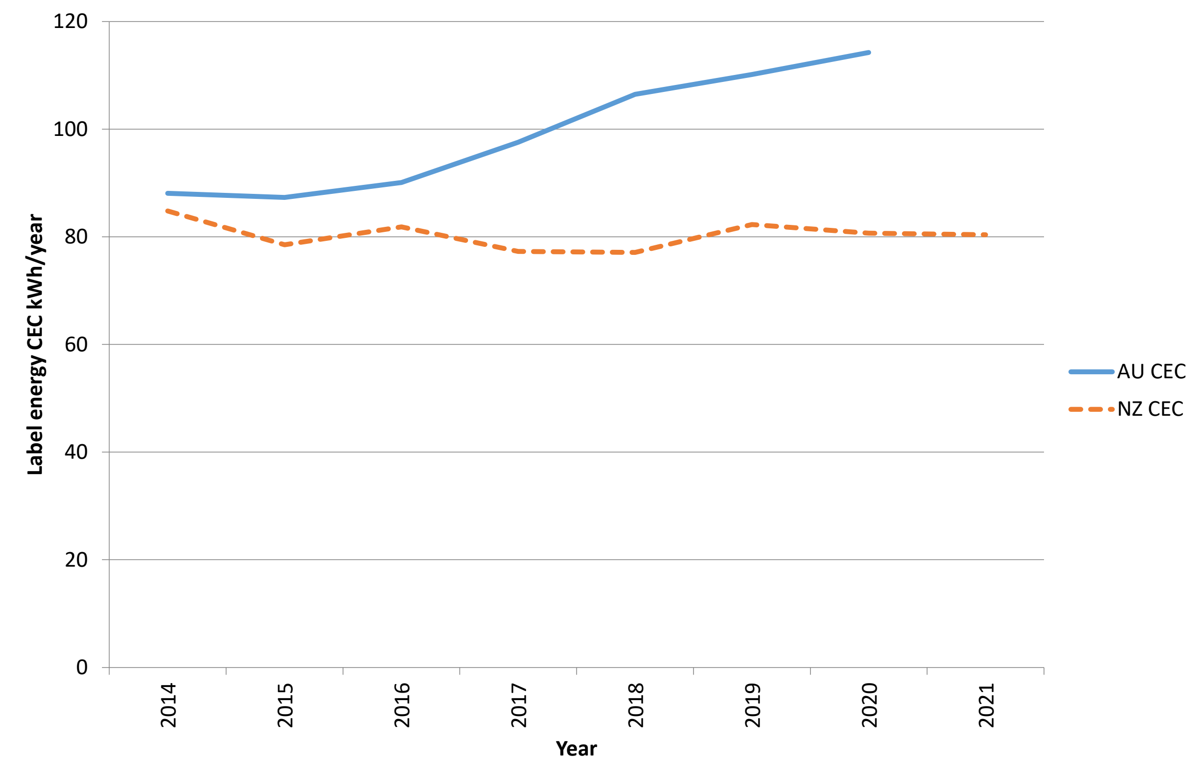

Figure 24: Trends in sales weighted computer monitor energy for Australia and New Zealand

It is clear that the increase in energy consumption (CEC in kWh/year) in Australia is partly driven by increases in size (as shown in Figure 25). However, the energy consumption is flat in NZ, despite some increase in screen size over the period. Examining the trends in on-mode power, as illustrated in Figure 26, shows that energy use of mid-sized monitors (20.5in to 25.5in and 25.5in to 30in) sold in New Zealand is substantially lower than in Australia. Mid-sized monitors make up the bulk of monitor sales in 2022.

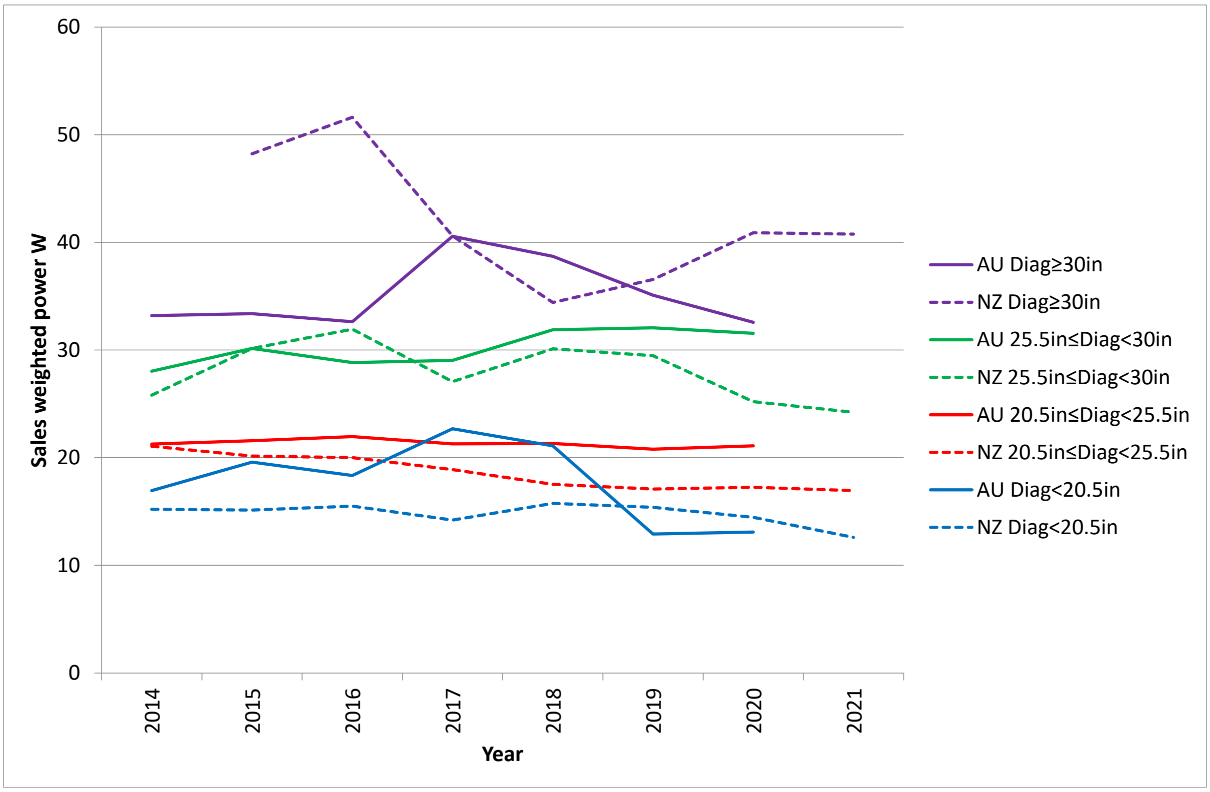

Figure 25: Trends in sales weighted on power for computer monitors split into size ranges for Australia and New Zealand

An examination of screen luminance values submitted with registrations revealed no significant changes over time as shown in Figure 26. This small increase will only account for a small part of the energy increase in Australia shown in Figure . Equivalent sales weighted data is not available for NZ.

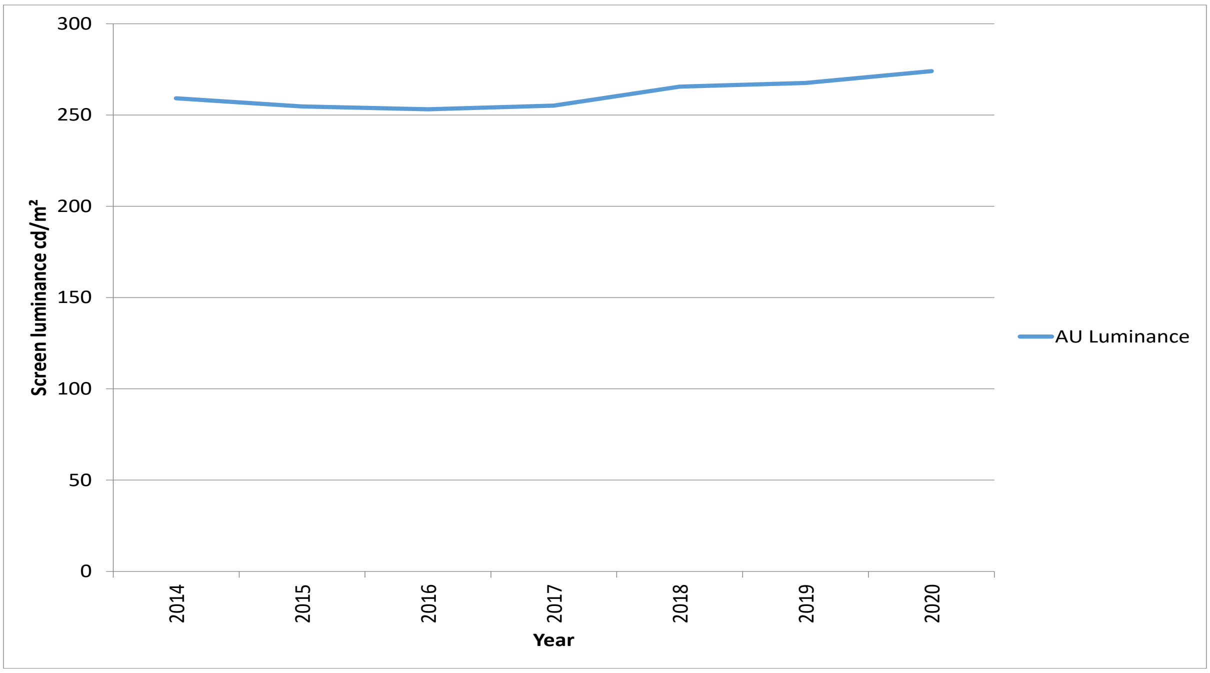

Figure 26: Trends in sales weighted luminance for computer monitors in Australia

Trends in the star rating index are shown in Figure 27. The improvement in NZ is due to the slightly declining energy consumption with increased screen size, whereas Australia is static. Given that the average SRI is now 5 stars, this shows that the label impact is likely to be lower as there is little differentiation between products.

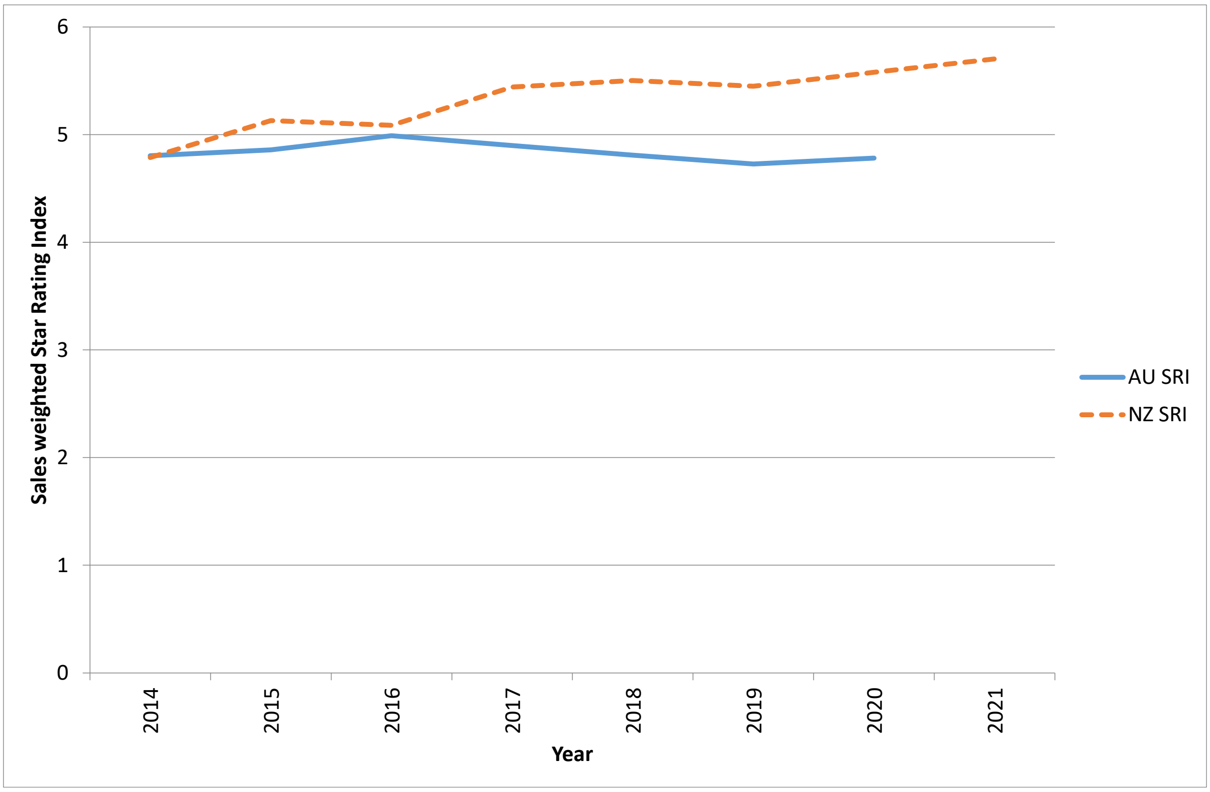

Figure 27: Trends in sales weighed star rating index for computer monitors sold in Australia and New Zealand

It is also clear from the current distribution of recently rated products that lower star rating bins are largely empty, meaning that many products rate 5 or more stars, thus rendering the label less effective, as illustrated in Figure 28.

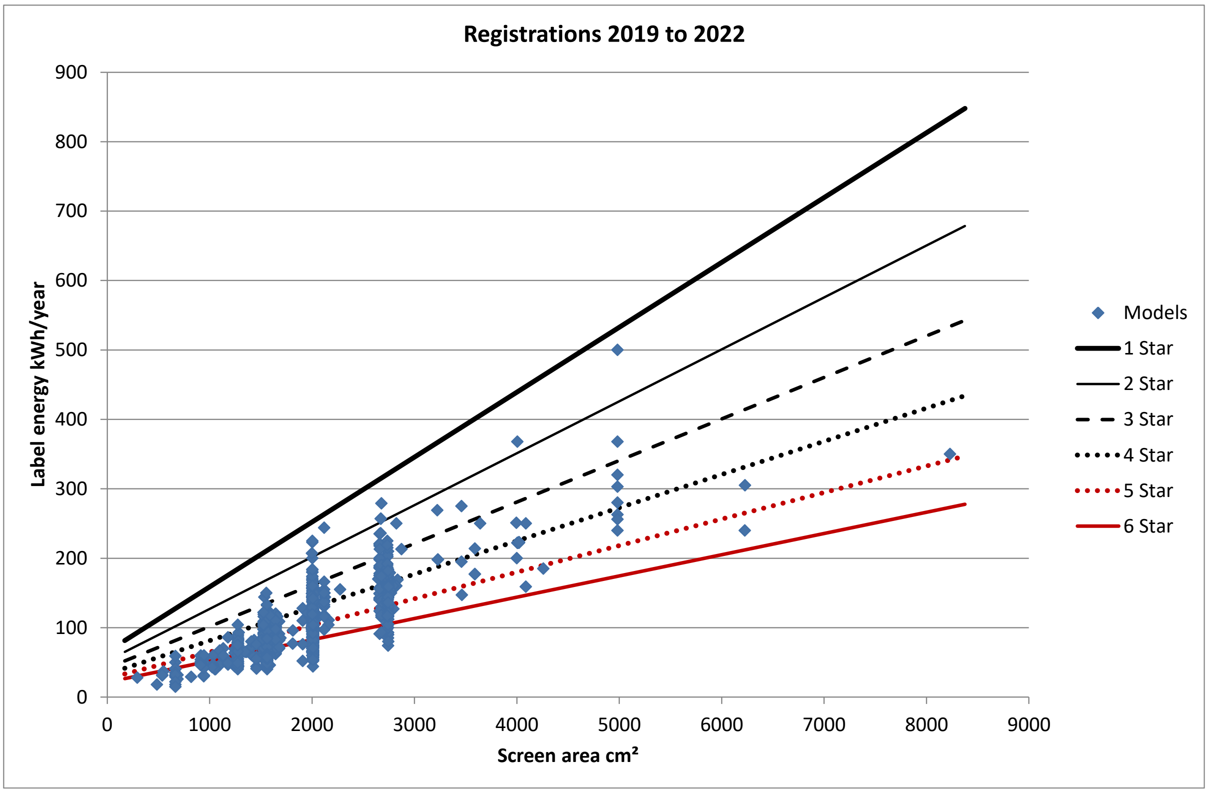

Figure 28: Current computer monitor star rating bands with products registered 2019 to 2022

Under the current determination and AS/NZS 5815.2, MEPS is defined in terms of a maximum permitted on-mode power for each model. The scope of MEPS applies only to products with a screen diagonal of less than 76 cm (30 inches), which equates to a nominal screen area of < 2,468 cm^2 (assuming a 16:9 aspect ratio, which is predominant). There are a significant number of products at 32 inches (81 cm or 2,823 cm^2), which are currently exempt from MEPS (but are covered by energy labelling). There is a more stringent MEPS level for standard definition monitors (≤ 1.1 Mpx) than for high definition (> 1.1 MPx) as defined in AS/NZS 5815.2. The current distribution of models registered from 2019 to 2022 is shown in Figure 29.

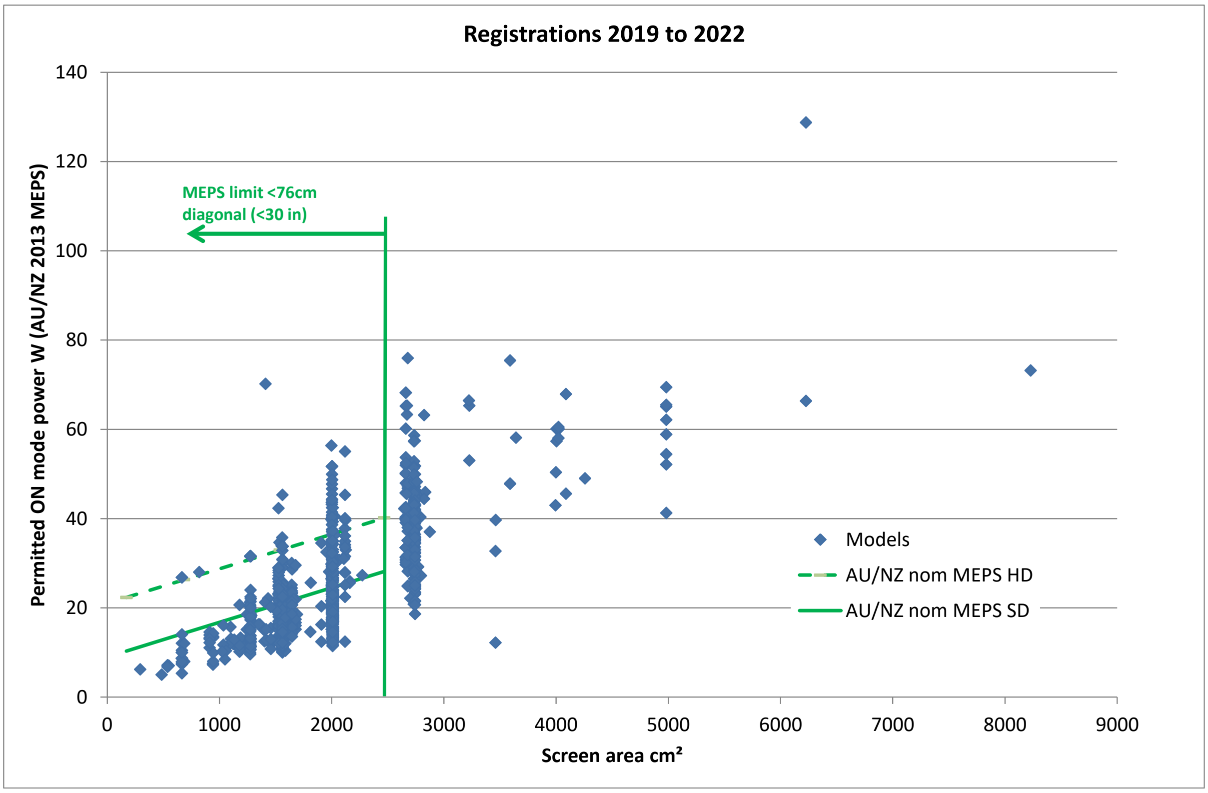

Figure 29: Distribution of on-mode power showing MEPS levels for models registered 2019 to 2022

The current Australian and New Zealand MEPS applies only to screens with a diagonal of less than 76 cm (green vertical bar). The nominal MEPS lines shown are for a standard definition (SD) screen of 1 MPx and for a high definition (HD) screen of 2 MPx. SD screens with lower resolution will have a more stringent MEPS level. HD screens with a higher definition will have a less stringent MEPS level (9W per MPx above 2 MPx). Models above the HD MEPS line all have higher resolutions and therefore have a less stringent MEPS levels and pass their model specific requirements.

Of the 1,336 new registrations from 2019 to early September 2022, just 12 (0.9%) were classified as standard definition (< 1.1 MPx) under the current standard and Determination.

While not recorded in the registration system, GfK sales note that a large number of models are now marketed as "gaming" monitors as illustrated in Figure 30. These are usually larger, higher resolution screens with a higher refresh rate and are classed as high performance, which are not covered by MEPS or the Energy Rating Label. This does suggest that the current scope and categories for labelling and MEPS are now somewhat outdated.

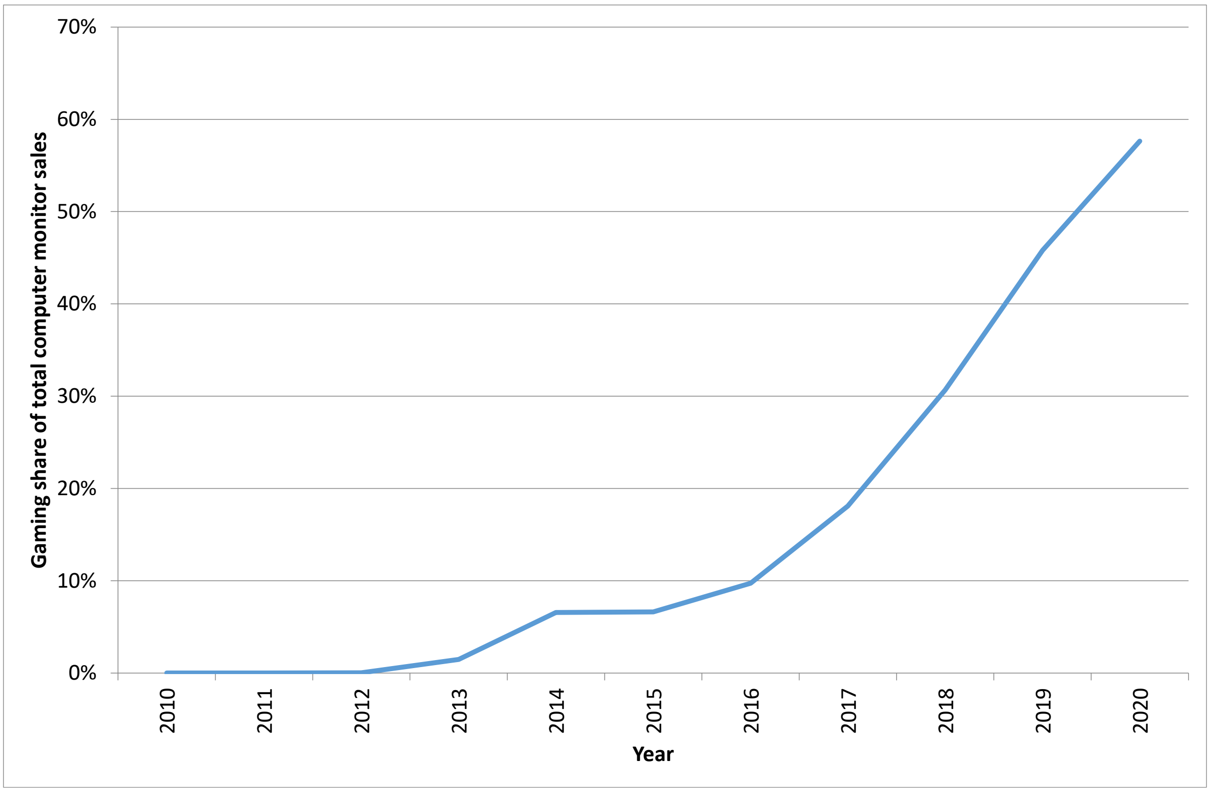

Figure 30: Share of gaming computer monitors in Australia

The European computer monitor database lists 3,625 models, of which some 110 (3%) have an ABC control that meets the EU policy requirements. In Australia and NZ, the presence of ABC controls is recorded in the registration system. The registration system shows that there were 139 monitors registered with ABC, out of a total of 2699 registrations (about 5%). For the purposes of this analysis to assess the policy impacts, it will be assumed that the same proportion of televisions in Australia and New Zealand will have a qualifying ABC control (3%) as found in Europe.

Baseline projections for modelling computer monitors – business as usual case

As set out in the previous analysis, most computer monitors are LCD or LCD (LED) technology and the attributes of these two technologies for monitors is quite similar, so only a single technology will be examined to project business as usual characteristics. While there are a couple of OLED monitors registered, it appears that their sales are likely to be negligible for the next few years.

To establish the baseline case where there is no change to the current policy settings, the market was split into 4 size ranges and each of these tracked historically to date and then projected into the future. The advantage of doing this is that energy and size parameters are more stable within a size range cohort and the market share of each size range into the future can visualised and adjusted based on the progression of historical data. The selected size ranges[18] for computer monitors are:

- Less than 20.5 inch screen diagonal (nominal area < 1,158.5 cm²)
- 20.5 inches ≤ screen diagonal < 25.5 inches (1,158.5 cm² ≤ nominal area < 1,792.6 cm²)
- 25.5 inches ≤ screen diagonal < 30 inches (1,792.6 cm² ≤ nominal area < 2,481.1 cm²)
- Greater than or equal to screen diagonal 30 inches (nominal area ≥ 2,481.1 cm²).

Over time, the sales weighted average area of these cohorts is relatively stable. The key parameter of interest for investigating the impact of the policies under consideration is the on-mode power, as this is the parameter specified in the EU regulation for electronic displays. This historical on-mode power for each size cohort in Australia and New Zealand and projected values to 2035 are shown in Figure 31 for each of the size ranges and each of the resolution levels covered by the EU regulations. The historical on-mode power has varied from -4% per annum to +2% per annum, depending on the size cohort and country. Given that most of the program impacts of the initial labelling and MEPS introduction have now settled, an assumed improvement rate of -0.5% per annum has been applied over the projection period as the business as usual case (without changes to current program settings).

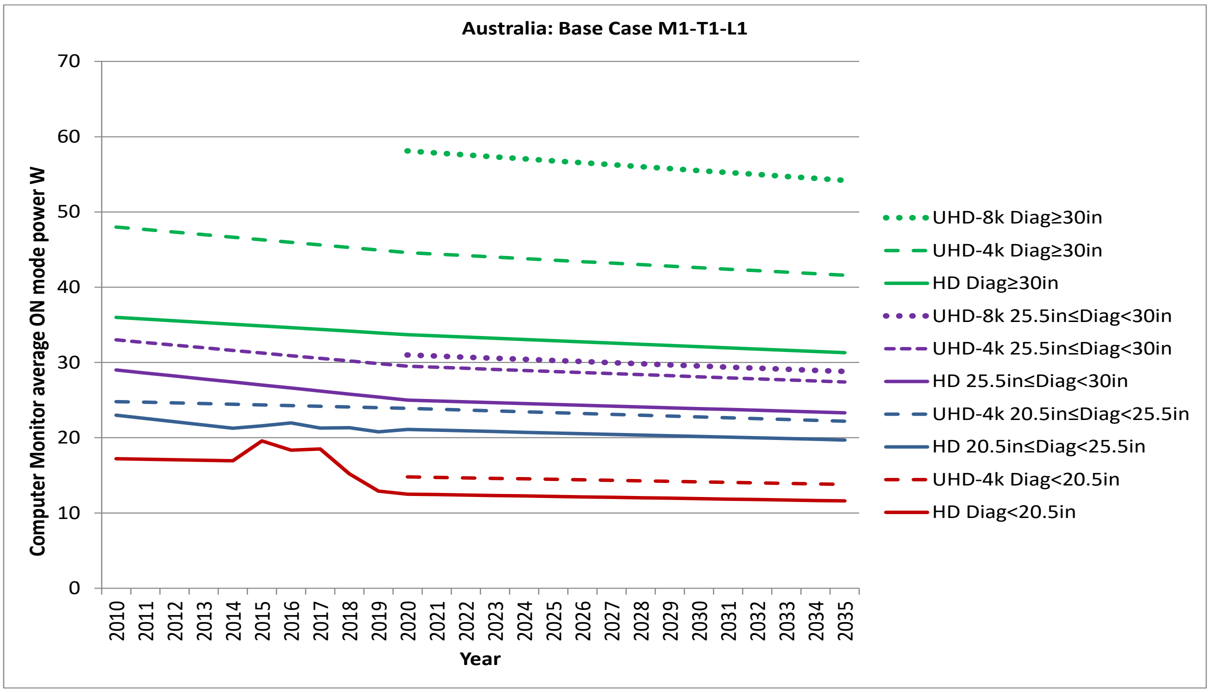

Figure 31: Historical and projected base case on-mode power for computer monitors by size range and resolution, Australia

[18] The proposed size cohort boundaries have been selected to avoid common size configurations in the market to ensure that all products of the same nominal size end up in the same bin.

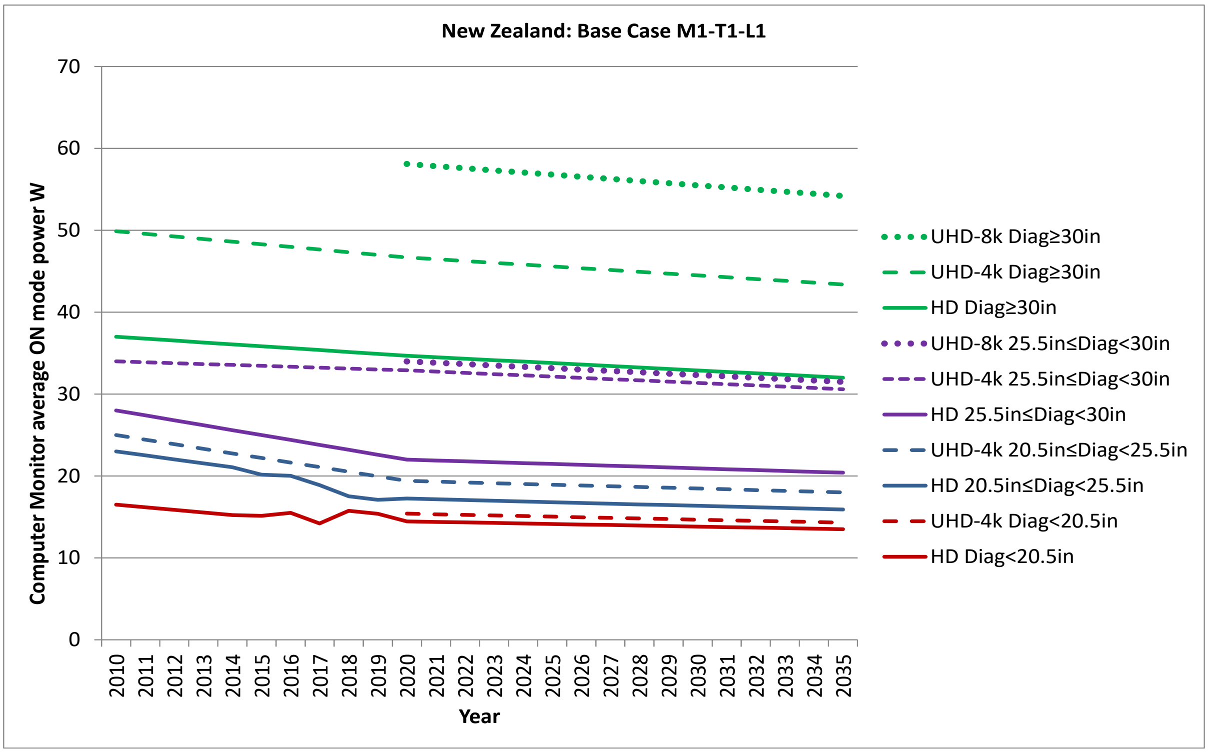

Figure 32: Historical and projected base case on-mode power for computer monitors by size range and resolution, New Zealand

The historical and projected sales share by size cohort for each country is also shown in the following figures.

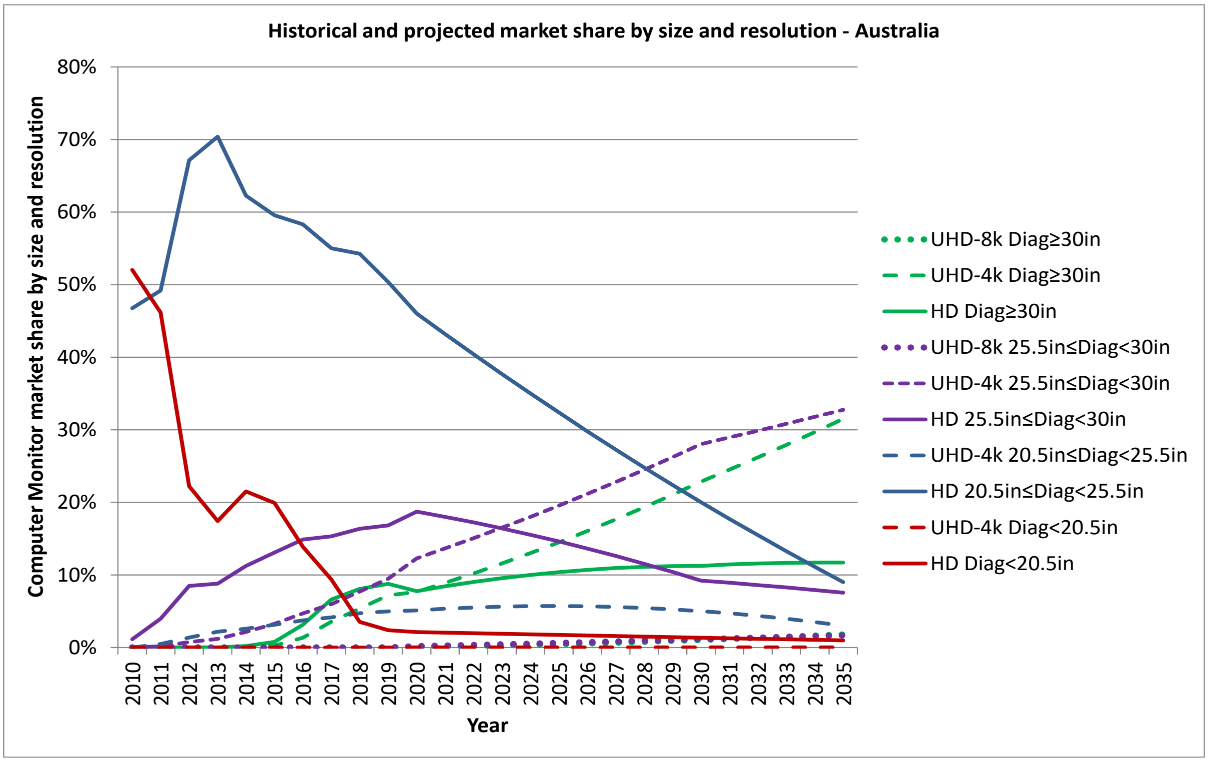

Figure 33: Historical and projected sales share for computer monitors by size range and resolution, Australia

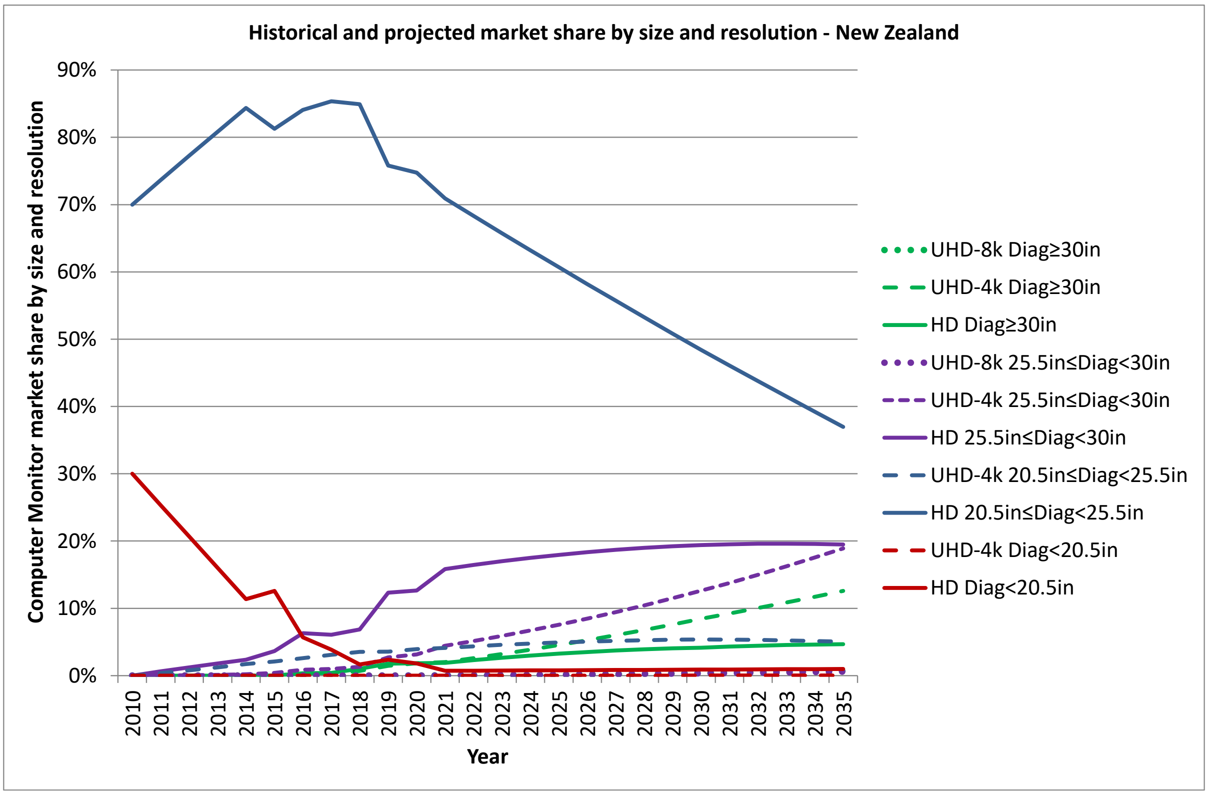

Figure 34: Historical and projected sales share for computer monitors by size range and resolution, New Zealand

Impact assessment of policy options for computer monitors

One of the core policy options under consideration is the adoption of the European Commission Ecodesign Regulation for electronic displays. Essentially this is a MEPS level for the on-mode power for an electronic display. The regulation also defines maximum permitted power levels for various low power modes, such as off-mode, Standby mode and Networked Standby mode, with adders for specific functions and an overall cap on the permitted power in each mode.

In order to assess the impact of the EU 2021 and EU 2023 Ecodesign levels on computer monitors currently on the market in Australia and New Zealand, the key performance parameters as defined in the EU regulation was determined for each model with a current registration as follows:

- Screen resolution and EU electronic display resolution category: HD, UHD-4k, UHD-8k
- The calculated Ecodesign *EEI* value for the model based on it measured on-mode power and screen area
- Determination of the applicable MEPS level for EU 2021 and EU 2023
- The maximum permitted power consumption for EU 2021 and EU 2023 in watts

- An assessment of whether the model currently passes EU 2021 and EU 2023 MEPS
- If the product does not meet the EU 2021 or EU 2023 MEPS requirements, the power target that the product would need to achieve in order to have a small margin below MEPS (nominal 5% margin)
- The EU labelling EEI_{label} index for the product and the relevant EU label grade
- The EU labelling EEI_{label} index after the impact of EU 2021 and EU 2023 MEPS where the power level has been adjusted to meet the EU 2021/2023 MEPS with a 5% margin.

Three separate data sources were used to assess the impact of the Ecodesign policies:

- Analysis of the registration database for computer monitors
- Analysis of sales data for Australia (GfK) from 2010 to 2020
- Analysis of sales data for New Zealand (EECA) from 2014 to 2021.

The impact analysis for computer monitors is much less complex than for televisions. This is because the size range is narrower (although this is growing wider), the main technologies in use are LCD (fluorescent backlight) and LCD (LED) and their attributes (size and energy performance) are relatively similar.

Table 5 summarises the characteristics for each of the key computer monitor product size categories and resolution levels defined in the Ecodesign regulations. Of the 925 computer monitor models registered after 31 December 2019, 74% of registrations pass the EU 2021 MEPS requirements and 54% of registrations pass the EU 2023 requirements. The overall energy impact for computer monitors appears to be lower than for televisions.

The estimated power impact of the Ecodesign regulations on computer monitors is set out in

Table 6. The impact varies to some extent when comparing the models registered with sales weighted data from Australia and New Zealand. The impacts vary by cohort and country, which reflects the mix of products sold. The last four rows illustrate the values for each country selected for energy modelling.

Table 5: Summary of EU Ecodesign MEPS impact on computer monitor models in Australia and New Zealand

Cohort – size/resolution → Parameter ↓	Diag <20.5in HD	Diag <20.5in UHD-4k	Diag <20.5in UHD-8k	20.5in≤ Diag <25.5in HD	20.5in ≤Diag <25.5in UHD-4k	20.5in≤ Diag <25.5in UHD-8k	25.5in≤ Diag <30in HD	25.5in≤ Diag <30in UHD-4k	25.5in≤ Diag <30in UHD-8k	Diag≥30in HD	Diag≥30in UHD-4k	Diag≥30in UHD-8k	Total
Models reg after 2019	37	4	0	345	36	1	197	118	1	44	141	1	925
Share reg models	4%	0%	0%	37%	4%	0%	21%	13%	0%	5%	15%	0%	100%
Models pass EU 2021	34	4	#N/A	280	29	#N/A	161	80	#N/A	22	78	#N/A	688
Models pass EU 2023	23	4	0	225	25	1	122	48	0	16	36	0	500
Models pass EU 2021	92%	100%	None reg	81%	81%	0%	82%	68%	0%	50%	55%	0%	74%
Models pass EU 2023	62%	100%	None reg	65%	69%	100%	62%	41%	0%	36%	26%	0%	54%
AU sales 2020	0.8%	0.0%	0.0%	31.8%	1.2%	0.0%	27.1%	14.6%	0.0%	15.8%	8.7%	0.0%	100%
Av SW size AU cm²	943	No sales	No sales	1539	1534	1562	2010	2097	2109	2743	2802	No sales	1822
Av SW size NZ cm²	930	No sales	No sales	1516	1601	No sales	2009	2042	No sales	2767	2886	No sales	1665

Table notes: Currently there are only 3 UHD-8k computer monitors registered, one in each of the larger size ranges. Registrations approved after 31 Dec 2019 up to 31 August 2022. #N/A indicates that MEPS for this cohort is not applicable (UHD-8k for EU 2021 MEPS). None reg means that no models were registered in that cohort over the specified period so the impact of MEPS on model availability could not be established. No sales indicates that there were no recorded sales in Australia or New Zealand, as applicable.

NZ sales data to 2021 was used in the modelling but has not been included in this table for confidentiality reasons.

Table 6: Summary of EU Ecodesign MEPS power impact on computer monitors in Australia and New Zealand

Cohort – size/resolution → Parameter ↓	Diag<20.5in HD	Diag<20.5in UHD-4k	Diag<20.5in UHD-8k	20.5in≤Diag <25.5in HD	20.5in≤Diag <25.5in UHD-4k	20.5in≤Diag <25.5in UHD-8k	25.5in≤Diag <30in HD	25.5in≤Diag <30in UHD-4k	25.5in≤Diag <30in UHD-8k	Diag≥30in HD	Diag≥30in UHD-4k	Diag≥30in UHD-8k
Power reg after 2019 W	11.3	8.6	None reg	17.3	22.9	14.5	21.1	29.8	31.0	33.7	44.1	58.1
Power after EU 2021 W	10.5	8.6	#N/A	16.0	20.1	#N/A	19.7	26.7	#N/A	28.6	39.0	#N/A
Power after EU 2023 W	9.9	8.6	None reg	14.9	18.8	14.5	18.3	23.7	25.8	25.3	33.8	39.8
Reg Power impact EU 2021	-7.2%	0.0%	#N/A	-7.4%	-12.0%	#N/A	-6.7%	-10.4%	#N/A	-15.0%	-11.5%	#N/A
Reg Power impact EU 2023	-12.6%	0.0%	None reg	-13.8%	-17.9%	0.0%	-13.4%	-20.3%	-16.8%	-24.9%	-23.2%	-31.4%
SW impact AU EU 2021	0.0%	No sales	No sales	-10.6%	-0.1%	#N/A	-20.0%	-14.2%	#N/A	-2.9%	-16.8%	No sales
SW impact AU EU 2023	-5.4%	No sales	No sales	-23.4%	-4.0%	No sales	-30.9%	-30.1%	-16.8%	-7.4%	-27.8%	No sales
SW impact NZ EU 2021	-3.1%	No sales	No sales	-4.2%	-7.1%	No sales	-5.9%	-12.4%	No sales	-10.7%	-17.3%	No sales
SW impact NZ EU 2023	-11.6%	No sales	No sales	-10.5%	-13.8%	No sales	-14.8%	-24.1%	No sales	-24.4%	-30.4%	No sales
AU impact for EU 2021	-5%	No model	No model	-10%	-5%	No model	-14%	-14%	0%	-10%	-15%	0%
AU impact for EU 2023	-10%	No model	No model	-18%	-12%	No model	-23%	-30%	-16%	-23%	-28%	-30%
NZ impact for EU 2021	-3%	No model	No model	-4%	-7%	No model	-6%	-12%	0%	-11%	-17%	0%
NZ impact for EU 2023	-12%	No model	No model	-11%	-14%	No model	-15%	-24%	-16%	-24%	-30%	-30%

Registrations approved after 31 Dec 2019 up to 31 August 2022. None reg means that no models were registered in that cohort over the specified period so the impact of MEPS on model availability could not be established. No sales indicates that no sales were recorded in Australia and/or New Zealand (as applicable) in the last year of available data. Assumed energy impact for modelling in Australia and New Zealand (last four rows) has been developed from sales weighted data over past 3 years and from registration data activity, which reflects the mix of products on sale in each country. NZ sales data is fairly complete so impact by cohort generally follows the sales weighted trend. For Australia, the data is less complete, especially for small monitors, so an estimate based on registration and sales weighted data was developed.

The relative impact of EU 2021 MEPS for each of main cohorts with product sales is illustrated in Figure 35.

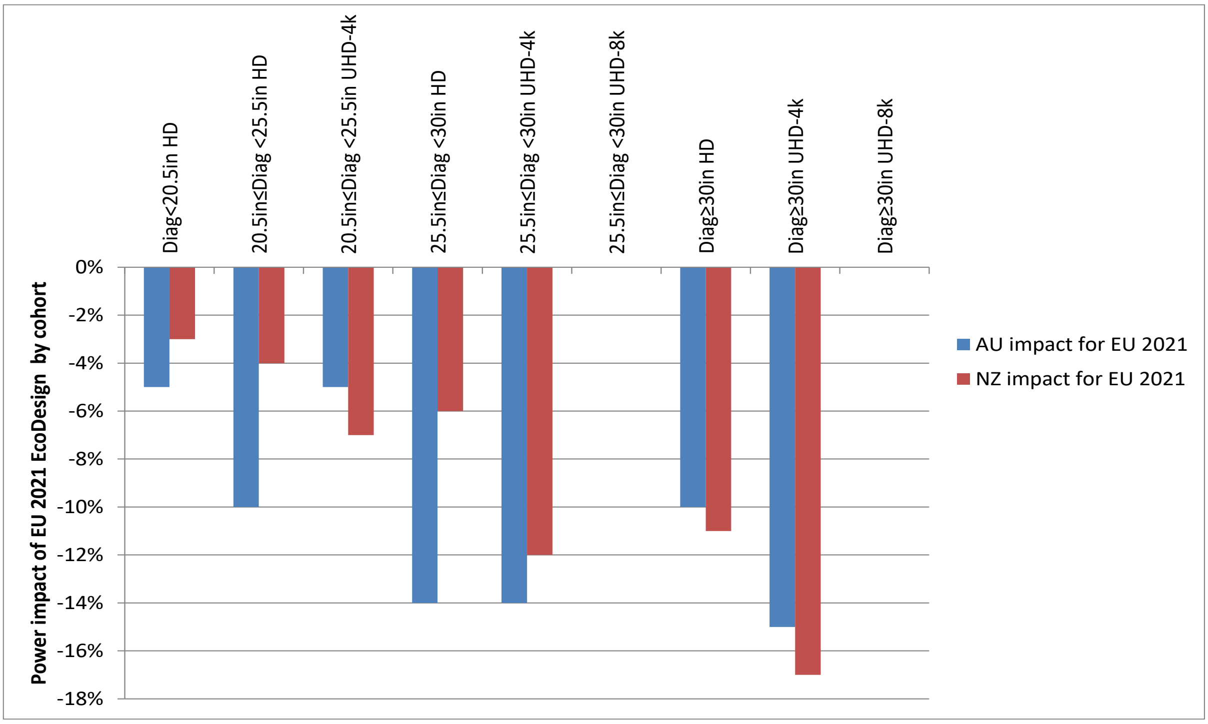

Figure 35: Expected change in on-mode power of current computer monitors from EU 2021 MEPS

The relative impact of EU 2023 MEPS for each of the main cohorts with product sales is illustrated in Figure 36.

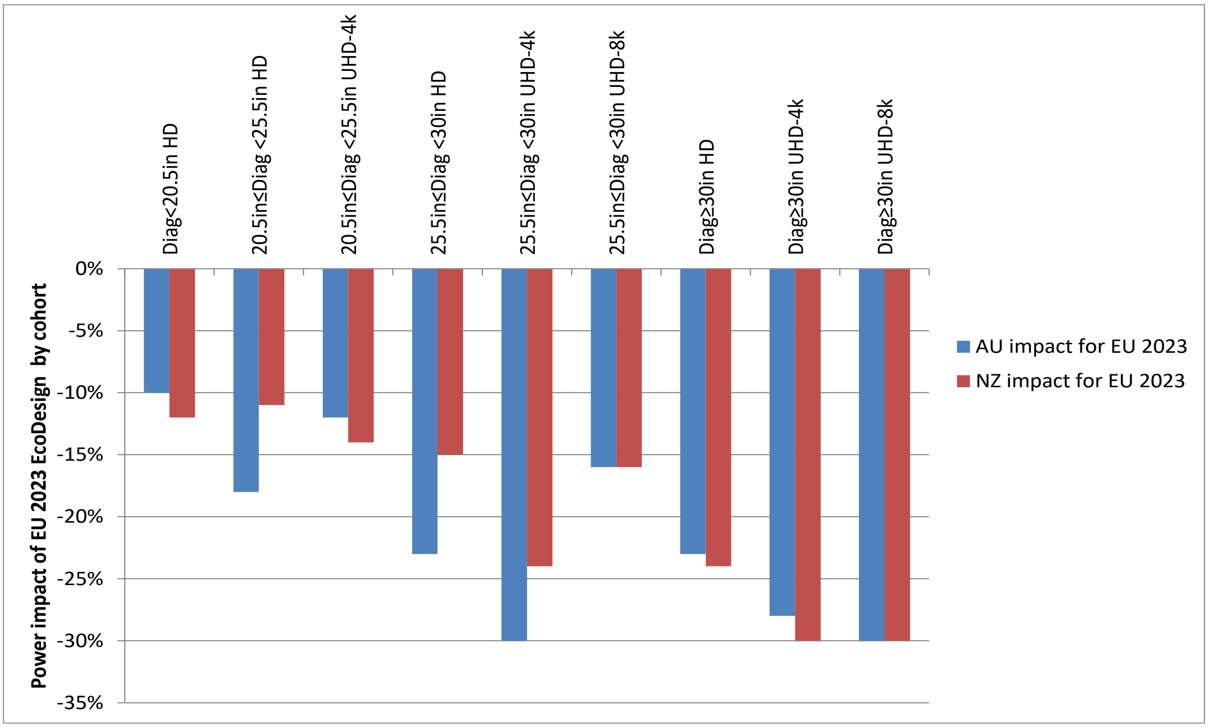

Figure 36: Expected change in on-mode power of current computer monitors from EU 2023 MEPS

The overall expected savings of EU 2023 MEPS for computer monitors in each of main cohorts is illustrated in Figure 37.

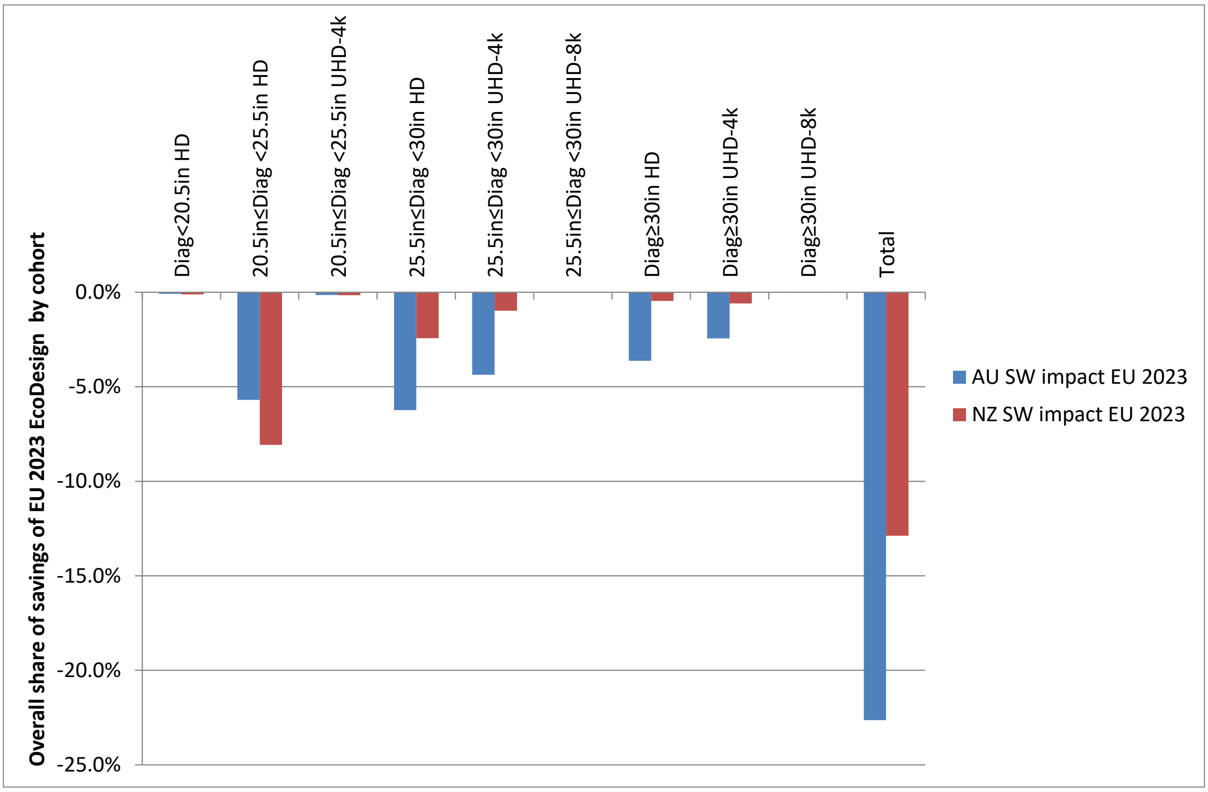

Figure 37: Expected overall energy savings for computer monitors from EU 2023 MEPS

Overall savings from EU 2023 MEPS for computer monitors are expected to be 23% for Australia and 13% for New Zealand. Impacts are larger in Australia as the EU requirements are more stringent for larger screens, which are more prevalent in Australia and the overall efficiency of the sales mix in New Zealand is already somewhat better than Australia prior to any policy implementation, resulting in a lower impact. Other impacts from the EU Ecodesign requirements are set out below.

Other impacts for computer monitors

Low power modes

As set out in the discussion on televisions, the impacts of the caps on power for low power models are expected to be very low as most products can already comply with these requirements.

Labelling impacts for computer monitors

Labelling impacts for computer monitors are expected to be the same as for televisions. The prevalence of smart wake features is currently rare for computer monitors, so a labelling approach that does not include low power modes is less of a potential issue.

Automatic Brightness Control

Around 5% of currently registered products are noted as having automatic brightness control. In Europe, about 3% of computer monitors claim to have ABC. As with televisions, complying ABC controls earn a 10% credit on the measured energy (effectively providing a 10% increase in MEPS level and label thresholds). For modelling purposes, it is assumed that qualifying ABC controls will save at least as much energy in normal use as the 10% allowance, so no explicit adjustment is necessary for energy modelling in this CRIS.

Baseline results – signage displays

Under current regulations in Australia and New Zealand, digital signage displays are not covered in any form. See Section 2.3.1 of the main CRIS document for information and definitions of this product category.

Currently Europe only mandates energy labelling for products within the scope. At this stage no MEPS are applied to on-mode power (but this may be considered in the future review of regulations).

Data from the European registration database EPREL is illustrated in Figure 38.

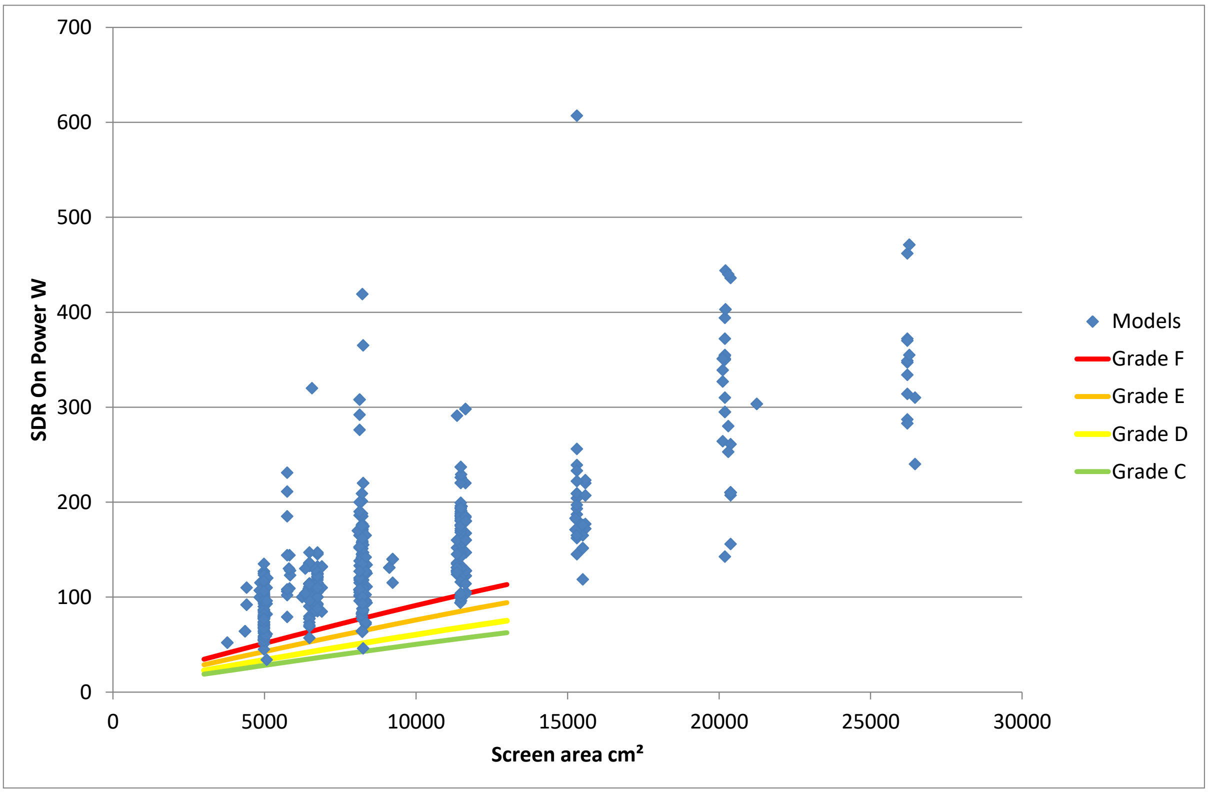

Figure 38: Distribution of signage display models from the EPREL database – on-mode power for Standard Dynamic Range (SDR)

Only Label Grade F to C from the European labelling scheme has been shown in this figure (energy must be below the line to reach the grade). Most products are currently rated Grade G (above the F Grade line). 604 models are shown, data with obvious errors has been excluded. Products below the regulation size threshold (<30 dm²) have also been excluded. Label grade lines are only plotted across the specified size range for the regulation for signage displays. Larger products may be entered on a voluntary basis.

There is little data regarding the stock or sales of these products in Australia and New Zealand. For the modelling, stock levels have been set to be similar to, but less than, those estimated in Europe, as illustrated in Figure 39.

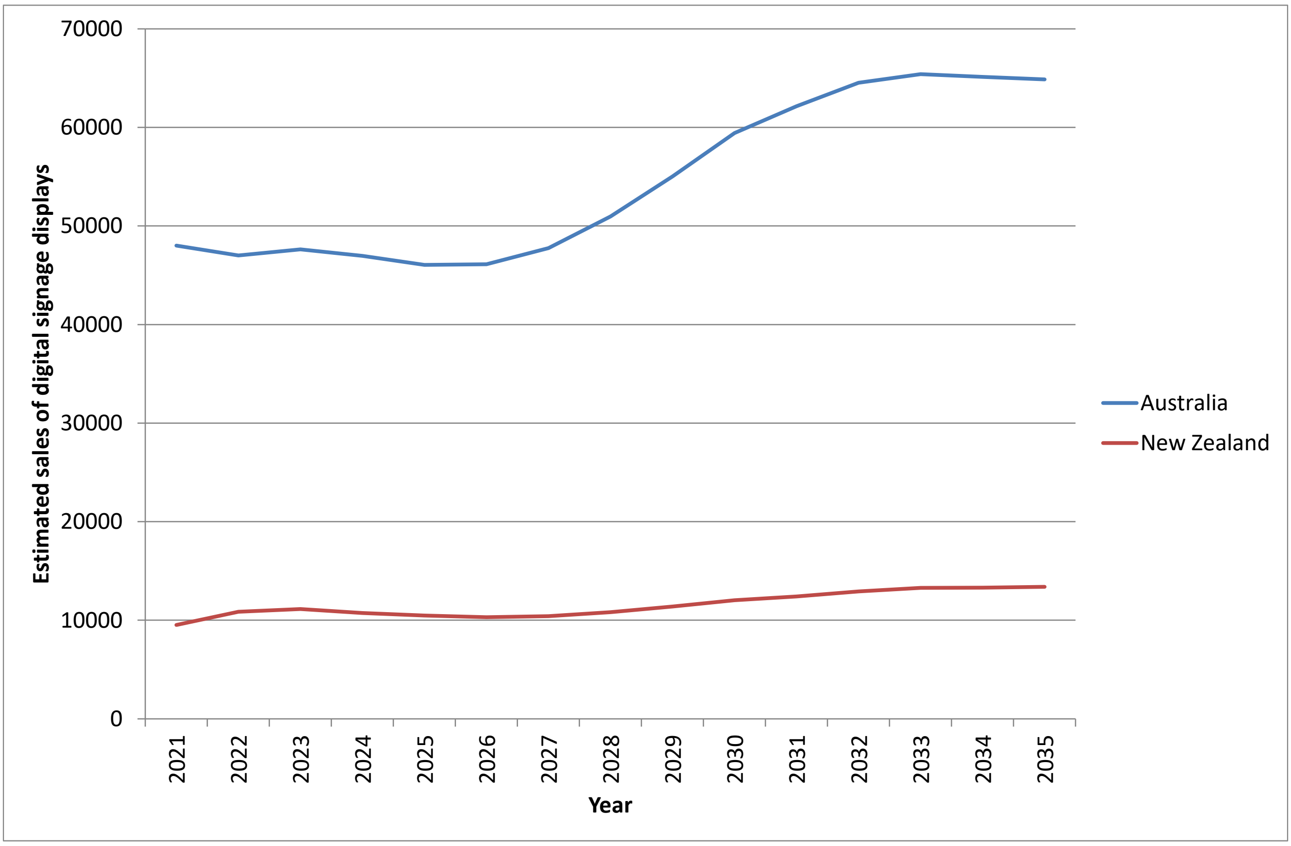

Figure 39: Estimated sales of digital signage displays used in the stock model

The baseline for energy projections assumed no improvement in energy over time in the absence of any policy. The introduction of energy labelling is assumed to result in an improvement of 0.5% per annum below the base case. This is very conservative, although signage displays are different to typical consumer products that carry an energy label. It is expected that most savings will be driven by corporate and government procurement initiatives.

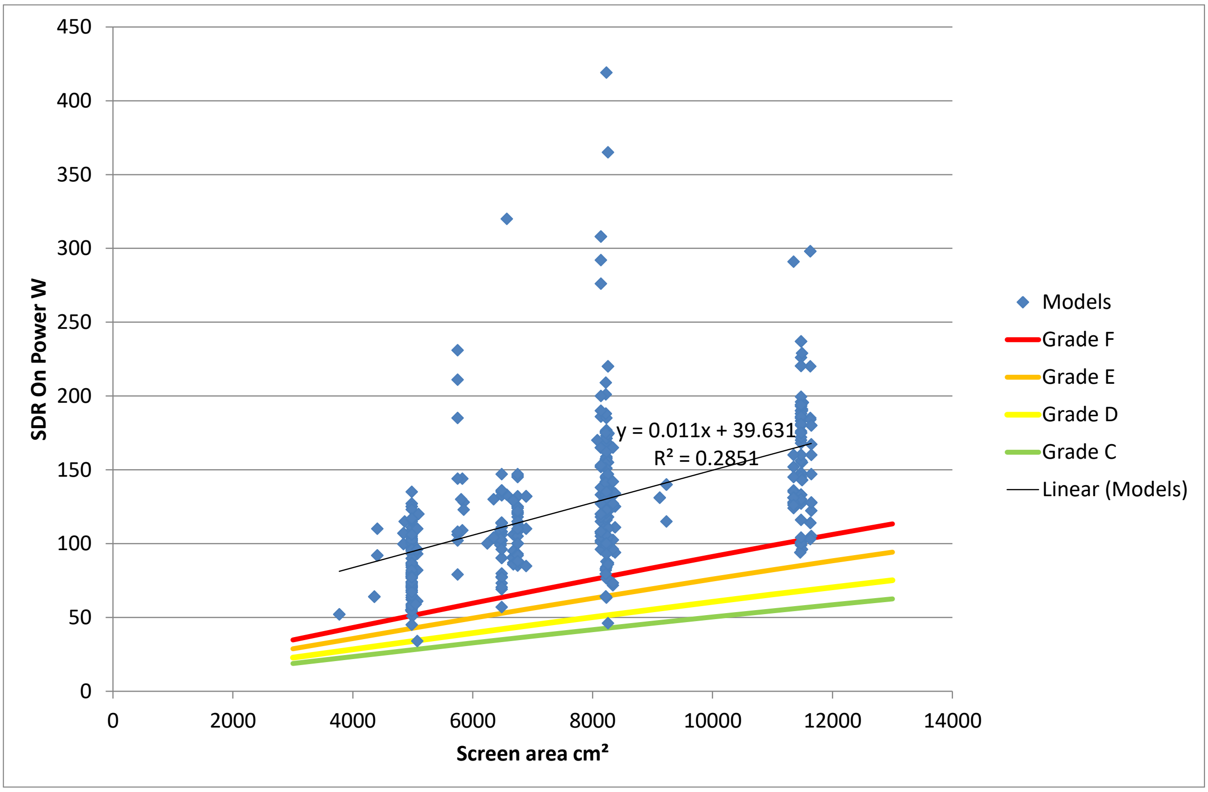

Figure 40: Linear regression of screen area versus on power for European products within the EU regulation size scope

Establishing stock and sales of products by sector

As examined in the previous sections, the EU regulations for electronic displays effectively have three distinct resolution categories: High Definition (HD), 4k and 8k resolution. After 2023, the EU requirements for 4k and 8k merge, leaving only two sub-categories. As both televisions and computer monitors are being split into four size categories, the input data for the stock model for this CRIS tracks 12 different sub-categories to track characteristics (4 size categories by 3 resolution categories). As noted previously, some of these categories have had no sales and are not likely to into the future.

Five separate stock models were developed to operate in parallel in order to estimate the energy consumption of the target appliances in this RIS:

- Residential sector televisions
- Commercial sector televisions
- Residential sector computer monitors
- Commercial sector computer monitors
- Digital signage displays (assumed to be commercial sector).

Each stock model tracks the number of installed units in each state and territory in Australia and New Zealand each year from 1990 to 2035[19]. It uses a normal distribution retirement function to determine the number of units that remain in the stock each year after its initial installation for a given average lifetime. This retirement function then weights the characteristics of each new cohort (year of installation) with all existing stock to calculate stock average characteristics each year over the modelling period. The stock model has inputs from as early as 1970, but as the policy impacts only occur from 2023 onwards, the differences between all scenarios is zero up to 2022. However, getting the magnitude of the stock correct is important as this has a direct bearing on the total energy consumption.

Total energy consumption for the products covered by this CRIS is impacted by the following parameters:

- Total stock installed and operating in each year over the modelling period
- Total hours in on-mode during the year
- Power characteristics in on-mode
- Total hours in STANDBY mode during the year
- Power characteristics in STANDBY mode.

Hours in on and STANDBY modes are applied to all of the stock in operation in a particular year. The hours of operation of all the stock in service in each year can be varied over time. The characteristics of the stock in operation in any particular year is a function of the weighted number and characteristics installed in previous years times the proportion of those units that remain in service.

A key input into the stock model was the number of households by state and territory in Australia. Historical data to 2021 was used with projections to 2041 from *ABS3236.0 Household and Family Projections, Australia, 2016 to 2041*. The base case used was Series 1 (assumes no change in 2016 living arrangement propensities). Note that the ABS has not yet updated household projections based on the 2021 census or the changes in regional populations driven by the COVID-19 pandemic, but overall state level changes are expected to be small. For New Zealand, household projections selected as the base case was the medium scenario under *Family and household projections: 2018(base)–2043* as published by Statistics New Zealand.

The number of businesses in Australia at a state level was as documented by *ABS8165.0 Counts of Australian Businesses*[20]. As a long-term time series was not available, the state ratio of businesses to households was used to estimate businesses prior to 2000 and to project businesses to 2035. Similarly, NZ business counts were used where available (2010

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[19] The stock model assumes that new units are installed up to 2035. Units installed up to 2035 are allowed to operate to the end of their normal life, meaning the last units are retired from the stock in around 2054 under a 12 year lifetime using a normally distributed retirement function.

[20] ABS Counts of Australian Businesses, including Entries and Exits

to 2021) with earlier estimates and projections made on the ratio of businesses to households. Note that these ratios were almost constant across the period where number of households and businesses were both known.

Ownership data for the residential sector for televisions and computer monitors is generally very good in Australia. This was tracked on a regular basis in *ABS4602.0 Environmental Issues: Energy Use and Conservation* up to around 2014. OzTAM[21], who undertake monitoring for commercial television ratings (for the residential sector) in Australia, undertake detailed stock surveys on a regular basis and this data has been stable for many years and closely matches the ABS data stream. The sales data for Australia and NZ is likely to be quite accurate for televisions.

The surge in TV sales during the technology change from CRT to flat screens and from analogue to digital through 2009 to 2015 is a bit difficult to characterise exactly. However, from the sales data and assumed lifetime, it appears that around 20% of the television stock is flowing onto the commercial sector. Televisions are now widely used in the services sector (for example, doctors, dentists, hospitals, clubs and pubs) and are also used for meetings and presentations. They are also used widely in hotels, motels and hospitals.

Compared to residential TVs, these displays may offer additional connectivity interfaces (welcoming to the hotel, activation of services via a remote command). However, many televisions in hotels, motels and hospitals are just normal residential TVs, possibly without a tuner[22].

For computer monitors, it is well documented that the prevalence of desktop computers in the residential was falling quickly from around 2005 and these were mainly being replaced by laptops. In recent times there has also been competition from a range of other screen types like smart phones and tablets[23]. Sales data in Australia showed a huge increase in monitor sales in 2020 at the start of the pandemic, mostly being used by people working remotely at home (this surge was somewhat less in New Zealand, but still obvious). While this is technically a business use, it occurs in the residential sector so has been counted as residential sector energy use.

It appears that the GfK computer monitor sales data is missing a significant proportion of the sales in Australia. Based on estimates from a range of sources, GfK seems to account for around half the total computer monitor sales in Australia (due to the fragmented nature of the retail chain for these types of products). NZ sales data appears to be reasonably accurate overall. The commercial sector has seen some decline in the use of desktop computers with a separate monitor, but nowhere near as dramatic as the

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[21] OzTAM website

[22] Source EU Impact assessment for electronic displays, 2019

[23] Think TV estimate that there are currently an average of 6.6 video capable screens per household in 2021 (Fact Pack H2). This CRIS is covering about half of these screens (televisions and separate computer monitors).

residential sector. The vast majority of computer monitors now sold are for use with laptop computers in either the residential or commercial sector.

It is assumed that New Zealand ownership for the residential sector and business sector will be similar to Australia (although the number of households per business is slightly higher in Australia).

The available data for digital signage displays was quite limited. Signage display panels are generally large electronic displays, either used indoor or outdoor, alone or in a composition called "video wall", to show content to many persons at once. In train stations and airports they are increasingly replacing mechanical signage technologies. Other typical applications are in meeting rooms, museums, churches, or in retail applications[24]. They are now quite prevalent in supermarkets, public areas of larger health care facilities and some education facilities.

Compared to residential televisions, signage displays offer a higher luminance/ contrast ratio (up to 2,500 cd/m^2 or more) to clearly display images in bright ambient conditions and daylight. A higher luminance increases the energy consumption. Market information is scarce in Australia and New Zealand, so stock levels have been set to broadly mirror EU estimates (with slightly lower stock levels). There is some uncertainty regarding the stock of these units.

Based on data from Europe[25], the estimated stock and sales stream generated by the stock model in Australia and New Zealand are consistent with European data for these products on a population weighted basis. The assumed ownership trends for each of the 5 product categories being covered by this CRIS are illustrated in Figure 41 below.

[24] Source EU Impact assessment for electronic displays, 2019

[25] Ecodesign Impact Accounting Annual Report 2020, prepared by VAN HOLSTEIJN EN KEMNA (VHK), May 2021

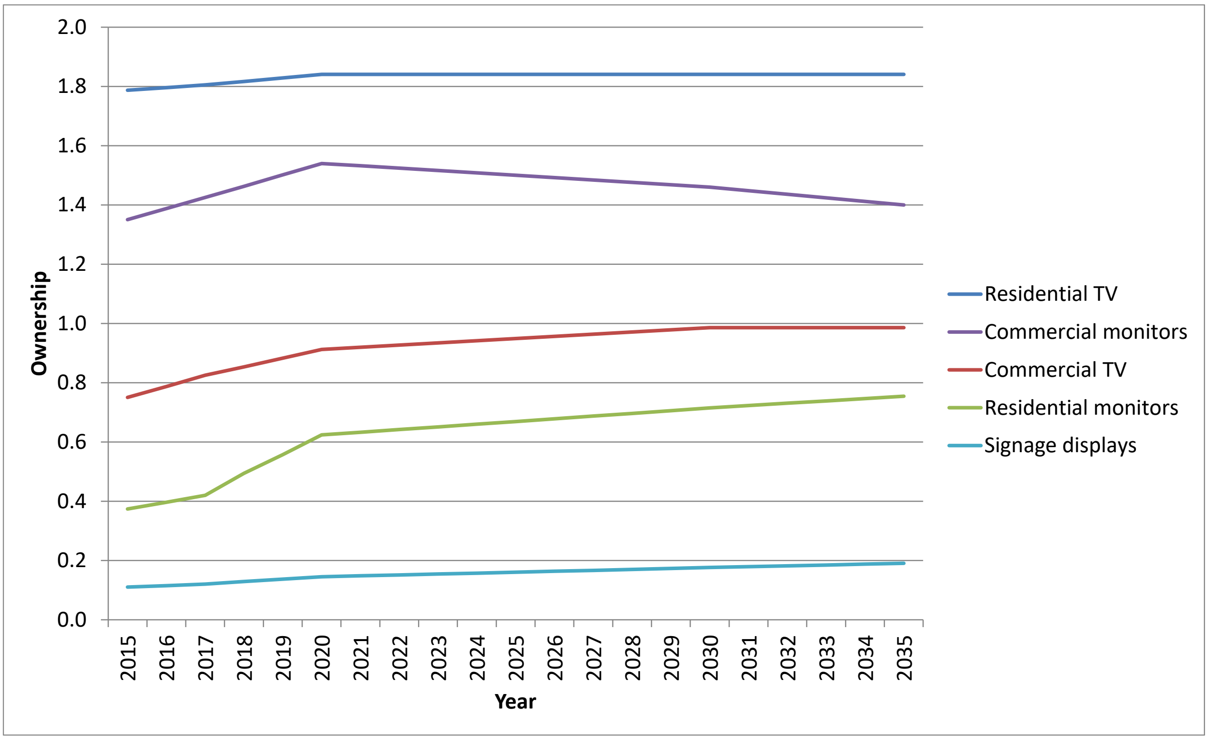

Figure 41: Assumed ownership trends for key products and sectors for stock modelling. Ownership is average stock per household or business. Note that the number of households and businesses used as the basis for ownership calculations is very different (there are generally 3 to 5 times more households than businesses). The ownership of residential computer monitors was decreasing until around 2012.

The approximate allocation of stock and sales by sector in the stock model is as follows:

- Around 85% of televisions are in the residential sector, with about 15% in the commercial sector in both Australia and New Zealand
- In Australia[26], about half of the computer monitor sales are for the residential sector with half in the commercial sector (in New Zealand this is more like 40% residential and 60% commercial). However, residential sector appears to make up about two thirds of the computer monitor stock in both Australia and New Zealand.
- 100% of digital signage displays are in the commercial sector.

There is limited data on the expected lifetime for these products, but examining the sales stream generated by the stock model for a given assumed lifetime does provide some indirect evidence. Lifetimes of 8, 10, 12 and 14 years were examined, along with the resulting sales streams for each product, based on the known stock.

A lifetime of 12 years for residential televisions and computer monitors and 10 years for commercial televisions and computer monitors generated a sales stream that was consistent with the available data, so this has been used as the basis for modelling.

[26] The stock model predicts a slowdown in residential sales after the surge in 2020/21. It also predicts an increase in replacements in around 2030 as units installed in 2020 are retired (the reality is likely to be a smoother transition that the model predicts).

A lifetime of 10 years for digital signage displays has been assumed based on the offer of some typical maintenance contracts[27] for this type of product. EU data showed that historical replacement rates for computer monitors in the commercial sector were 9-11 years. This appeared to drop dramatically as the stock of CRT monitors was replaced with flat screen technologies. However, apparently replacement rates (as a proxy for lifetime) are now increasing to over 9 years, so are likely to stabilise again at around 10 years[28]. The EU report noted that computer monitors were generally replaced because of functional requirements (i.e. size, resolution), but rarely because the display was broken.

The assumed retirement function and stock remaining after the year of installation (year zero) for a lifetime of 12 years as used in the stock model is shown Figure 42 and Figure 43. A modified function that is narrower is used for a lifetime of 10 years.

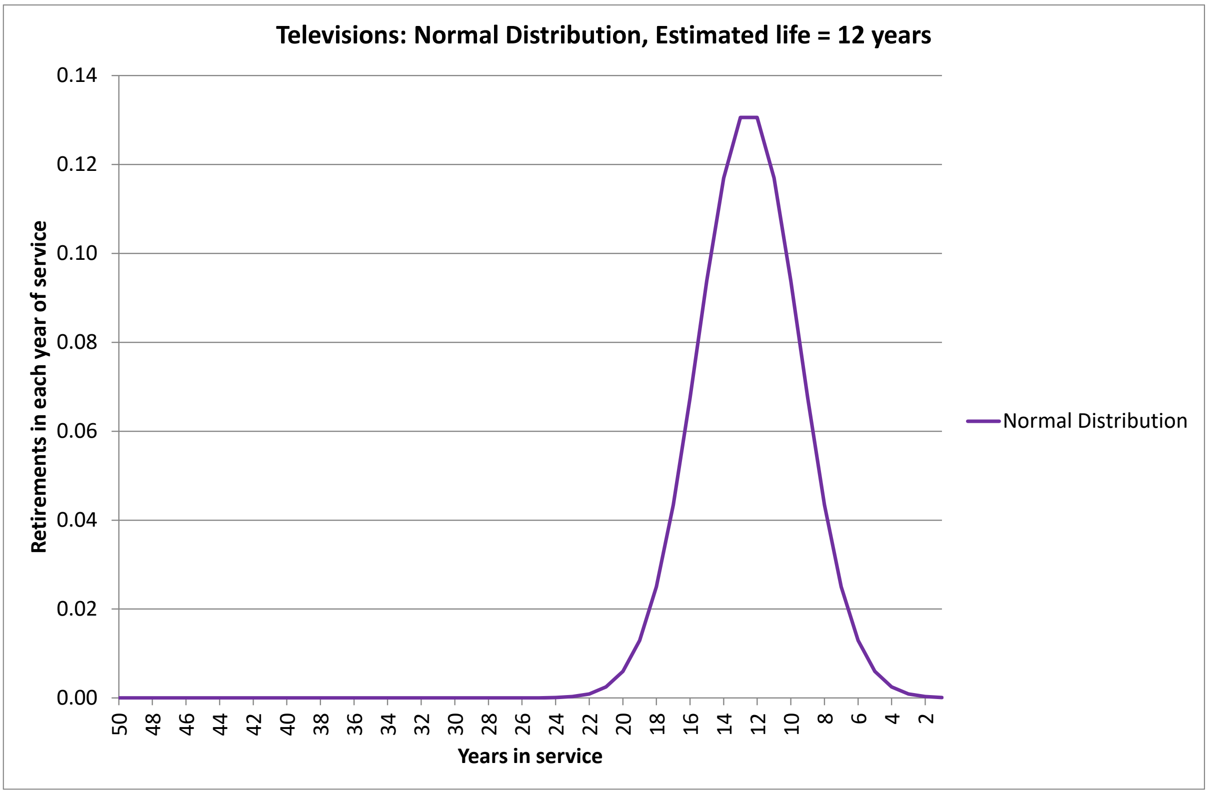

Figure 42: Normal distribution retirement function used in the stock model

[27] See signage displays https://www.bigscreenvideo.com.au/support/
[28] Source EU Impact assessment for electronic displays, 2019 – see https://www.vhk.nl/downloads/Reports/2019/IA_report-swd_2019_0354.pdf

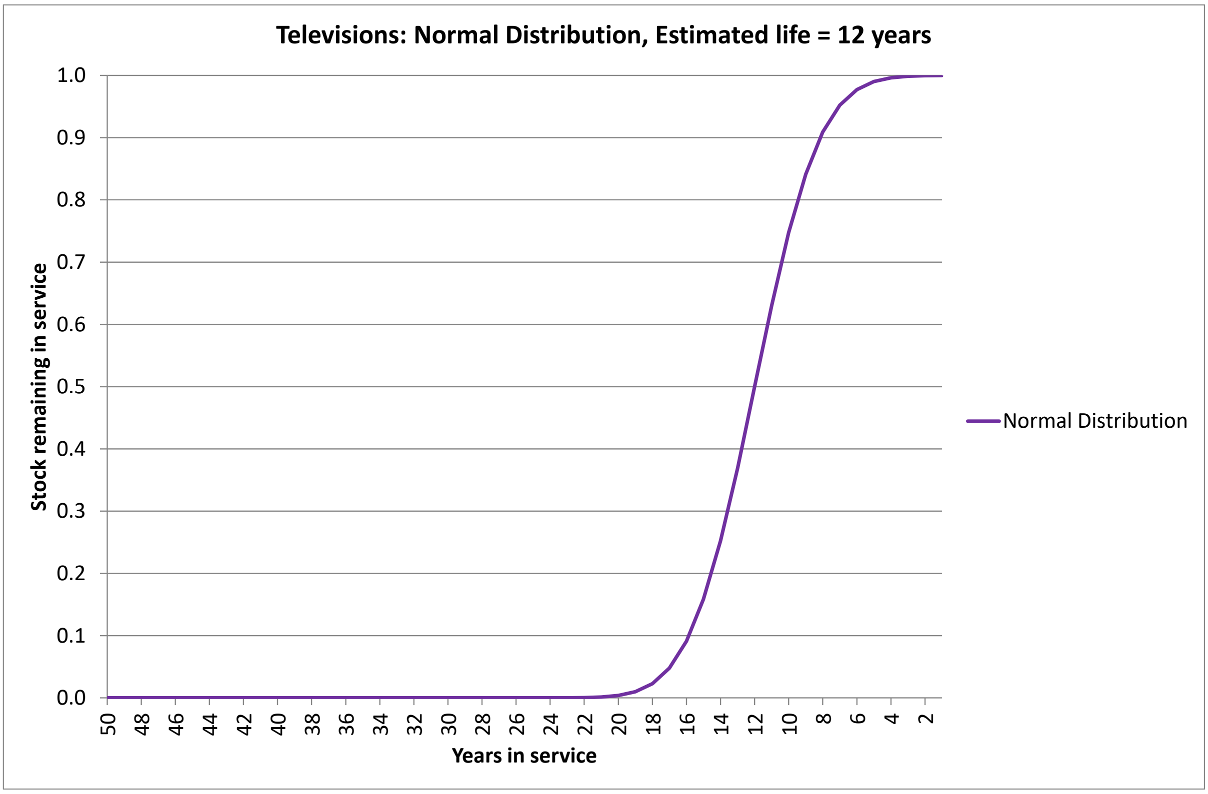

Figure 43: Normal distribution stock remaining in service function used in the stock model

Usage assumptions

The current energy label for televisions and computer monitors assumes on-mode of 10 hours per day (3,650 hours per year), with the remaining time in standby. Based on all available data, this is likely to be too high to accurately estimate the energy consumption during normal use.

Detailed end use energy measurements over a period of weeks to months of more than 200 televisions in Australia showed that main televisions were, on average, in on-mode for around 5.5 hours per day, with secondary televisions used about 1.0 to 1.5 hours a day (based on a small sample for secondary televisions). However, the variation across different households was quite significant. ThinkTV data shows higher viewing levels for children and people over 35 years with lower levels for teenagers and adults up to 34 years[29].

OzTAM is a commercial organisation that monitors television usage in Australia[30]. The main objective is to document the number of people and number of television sets in use and what channels or other sources of material that householders are watching. This data forms the basis of television commercial ratings, which is used to set advertising prices at

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[29] ThinkTV Fact Pack H1 2022

[30] OzTAM is the official source of television audience measurement (TAM) covering Australia's five mainland metropolitan markets (Sydney, Melbourne, Brisbane, Adelaide and Perth) and nationally for subscription television. OzTAM owns and holds the copyright for the television audience data it delivers. See

different times of the day. The OzTAM data has a large stable sample that is tracked over many years. OzTAM continuously monitor all televisions in more than 4500 households across Australia (representing more than 8000 television sets) that are carefully selected and weighted to be representative of the total population.

OzTAM track use of different devices in the home and this shows that 96% of broadcast viewing is still undertaken on televisions. The Department of Climate Change, Energy, the Environment and Water commissioned OzTAM to extract data on the hours of television use over the past 6 years. This data is different to their normal published data as it focused on the ON hours for televisions irrespective of the source of video[31] (broadcast, video on demand, games, other online sources).

Hours of use per day are shown in Figure 44. This data converts to an average viewing time of 3.7 hours per television (which equates to 6.9 hours of viewing per household across an average of 1.85 televisions per household). The small increase in total television hours during the pandemic lockdowns are being ignored in future projections. Total hours of use, even when the source of content is changing, appear to be very stable over time. 3.7 hours per day equates to 1,350 hours per year. By way of comparison, the Ecodesign impact accounting annual report 2020[32] assume 4 hours usage of televisions per day for both residential and commercial sectors, which closely matches Australian data.

For televisions used in the commercial sector, there are few data sources. Some installed in spaces like doctors, dentists, libraries and hospitals may be used for quite long hours, but usage will be short for in the businesses sector when used in meetings rooms or in hotel or motel rooms. For modelling purposes, the same hours of use are assumed for residential and business applications, which mirrors the EU assumptions.

[31] Sources include broadcast TV (live, playback when watched to 28 days for Free to Air and Subscription TV) as well as gaming, viewing broadcaster catch up services, streaming music and watching video on platforms such as YouTube, Facebook as well as accessing subscription video on demand services such as Netflix and Stan.
[32] See EU Ecodesign impact accounting annual report 2020

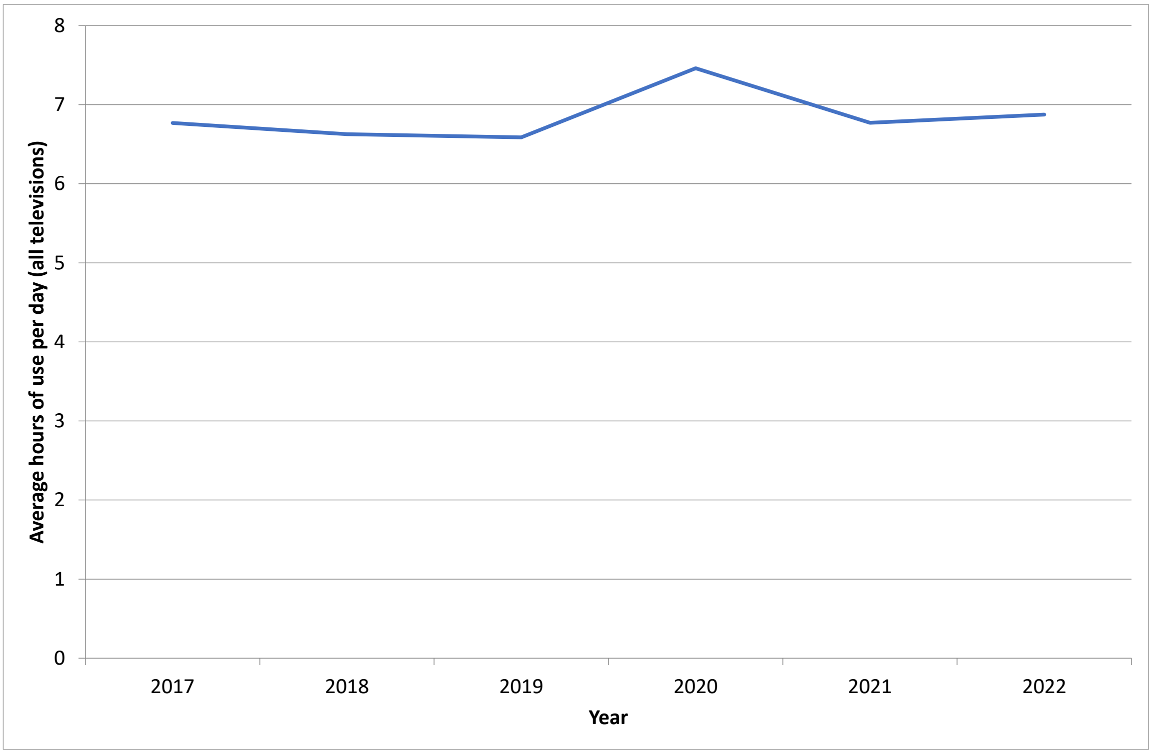

Figure 44: Total hours of use of televisions in Australia by year from OzTAM data extraction commissioned by DCCEEW. Based on viewing data for May in each year for all televisions from all sources. Excludes increases in viewing hours generated by the Summer Olympics over 2 weeks in September 2021 but does include the impact of pandemic lockdowns in 2020.A total of 6.9 hours per day per household in 2022 equates to 3.7 hours per day over 1.85 televisions per household.

While efficiency standards (MEPS) are primarily focused on reducing energy consumption, more efficient televisions with lower energy will also have an impact on system peak demand. To better understand the load shape for household televisions, two data sources were examined. The first was from the Pacific Power *Residential End-Use Study* (1994), which measured the energy consumption of around 50 televisions over a year in NSW houses.

The second source of data is from ThinkTV (associated with OzTAM) who published television time of use data in their fact pack[33]. These two sources are illustrated in Figure 45. Even though the Pacific Power data is 25 years old, the usage pattern appears to be almost the same as current data from 2022 (although the absolute power levels will no longer be relevant). From this data we can estimate that the peak power (which occurs in the evening at around 19:30) is 2.7 to 3.1 times higher than the average power across the day[34]. The peak power reductions are assumed to scale with changes in energy resulting from program impacts. This provides a method of estimating peak load reductions that

[33] ThinkTV Fact Pack H1 2022

[34] If ABC is active, then the peak power in the evening may be reduced to some extent due to lower ambient lighting levels in the home. A peak to average ratio of 2.5 has been assumed for the estimation of peak load reductions.

result from MEPS and energy labelling efficiency improvements. While this is a secondary benefit, it is worth quantifying.

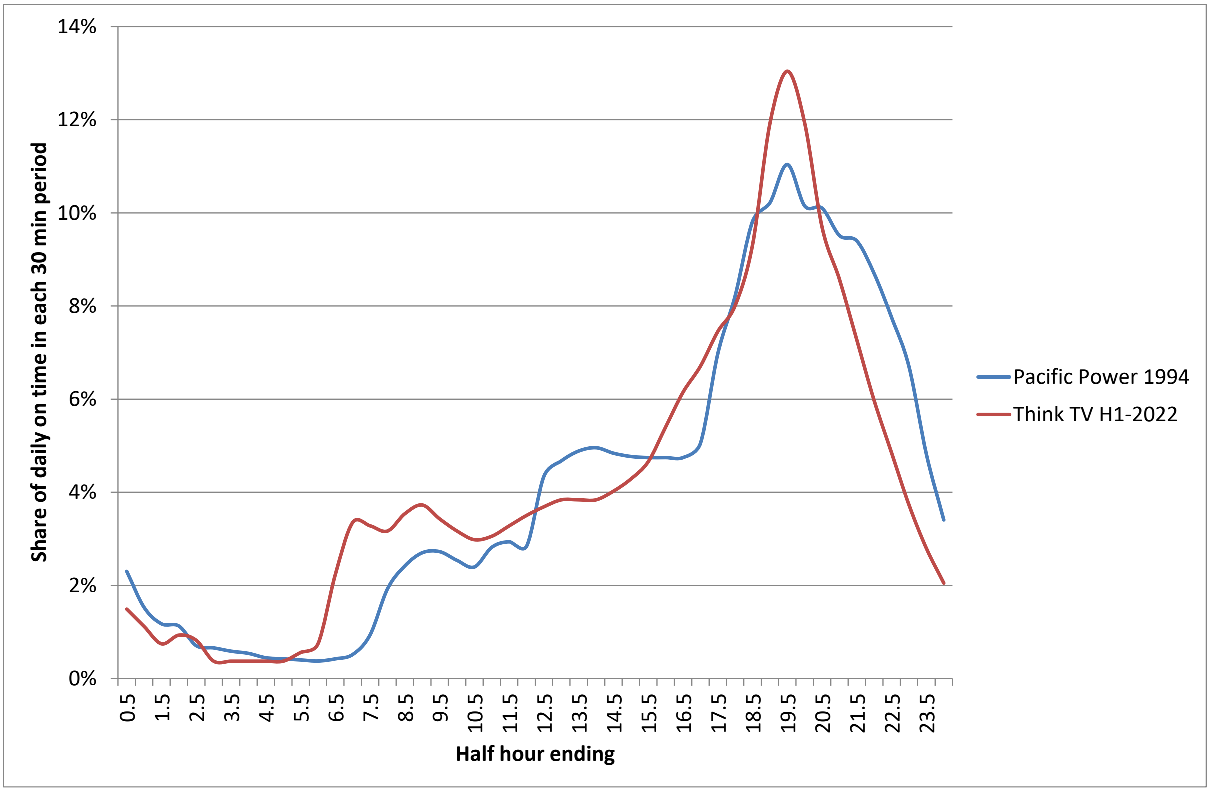

Figure 45: Share of ON time in each 30 minute period during the day

Many televisions do not have an OFF switch so will enter standby mode when powered off via the remote control. Few users would now attempt to disconnect televisions from the power when not in use. For modelling, it is assumed that the time in standby mode is 24 minus the number of ON hours. Given that standby power levels are now generally very low, this makes only a small contribution to overall energy consumption. However, one issue of concern is the growing prevalence of so-called “smart wake” features, where the television can be activated via a mobile app or via a voice command. Some models currently on the market have high power levels in this mode and this does not seem to be captured by the EU High Network Availability mode definitions. These features are explicitly captured by the US test method CTA2037D.

For computer monitors, there is little firm data available on typical hours of use. The current energy label for computer monitors assumes 10 hours per day in on-mode with the balance in standby mode. This would seem to be an overestimate. EU modelling uses a figure of 4 hours a day for 365 days per year which equates to 1,460 hours per year. This equates to approximately 7.3 hours per day for 200 working days per year. Given that computers are often unattended for periods when there are meetings, lunch etc. and monitors would typically go to sleep during these periods, this estimate is possibly on the high side. However, there will be a distribution of uses and some monitors will be used continuously for very long hours, while some residential monitors will be used for short periods.

A majority of monitors in the residential sector are now likely to be used for remote working, so these would mirror business usage. For modelling in this RIS, it is assumed that computer monitors will be in on-mode for 6 hours per work day, equating to 1,200 hours per year in the commercial sector. For the residential sector, computer monitor use is assumed to be 1,000 hours per year. The stock model increased the residential hours by 200 per year in 2020 and decreased the commercial sector hours by 100 a year in 2020. These adjusted hours are assumed to persist to 2035 and reflect the increased level of working from home during and after the pandemic. These historical changes in assumed hours of use have no impact on the program impact estimates being examined in this CRIS because they occur before any program implementation impact occur, but they are an attempt to ensure that total energy estimates for these products are as accurate as possible.

EU stock modelling assumes that computer monitors are in standby mode for 4 hours per day. This means that they are assumed to be in off-mode for the remaining 16 hours per day. It is not clear where this assumption has come from, as most monitors now have soft power switching and even where there is an OFF button, the power consumption is likely to be similar to standby mode.

Around 30% of AU/NZ registrations record an off-mode power value, and the average of these is 0.23W over the period 2020 to 2022, compared to the standby power of 0.33W over the same period for all monitors. Given the difference between these modes is small and off-mode is only applicable to a small share of the available models, for modelling purposes, it is assumed that for both sectors, computer monitors will be in standby mode for 8,760 hours minus on-mode hours. For modelling purposes, it is assumed that monitors will remain connected to a power source when in standby mode.

Very little direct data is available regarding the use of digital signage displays. The expectation is that these will be used for long hours as they are deployed in high-use public areas. The EU modelling assumes 12 hours per day in on-mode and 1.8 hours per day in standby mode. As most of these devices are mounted in inaccessible locations (high on walls of hanging from the roof) and are hard wired, it is not clear how these devices could be disconnected from a power source or put into a low power mode other than a network ready mode. Many products registered in Europe just meet the High Network Availability limit of 5W and few have an off-mode. For the purposes of modelling, it is assumed the digital signage displays will be in on-mode for 12 hours per day (4,380 hours per year) and in the relevant low power mode for the remaining 4,380 hours per year (predominantly networked standby mode).

Price data

With the Australian data, where the actual price paid has been tracked by model, it is possible to examine longer term trends in size, energy and price. For this analysis, nominal prices paid each year have been corrected to real prices in 2022 dollars using the ABS Cost Price Index[35]. No price data was available for New Zealand.

Televisions

Firstly, it is useful to examine overall long-term trends for televisions, as illustrated in Figure 46.

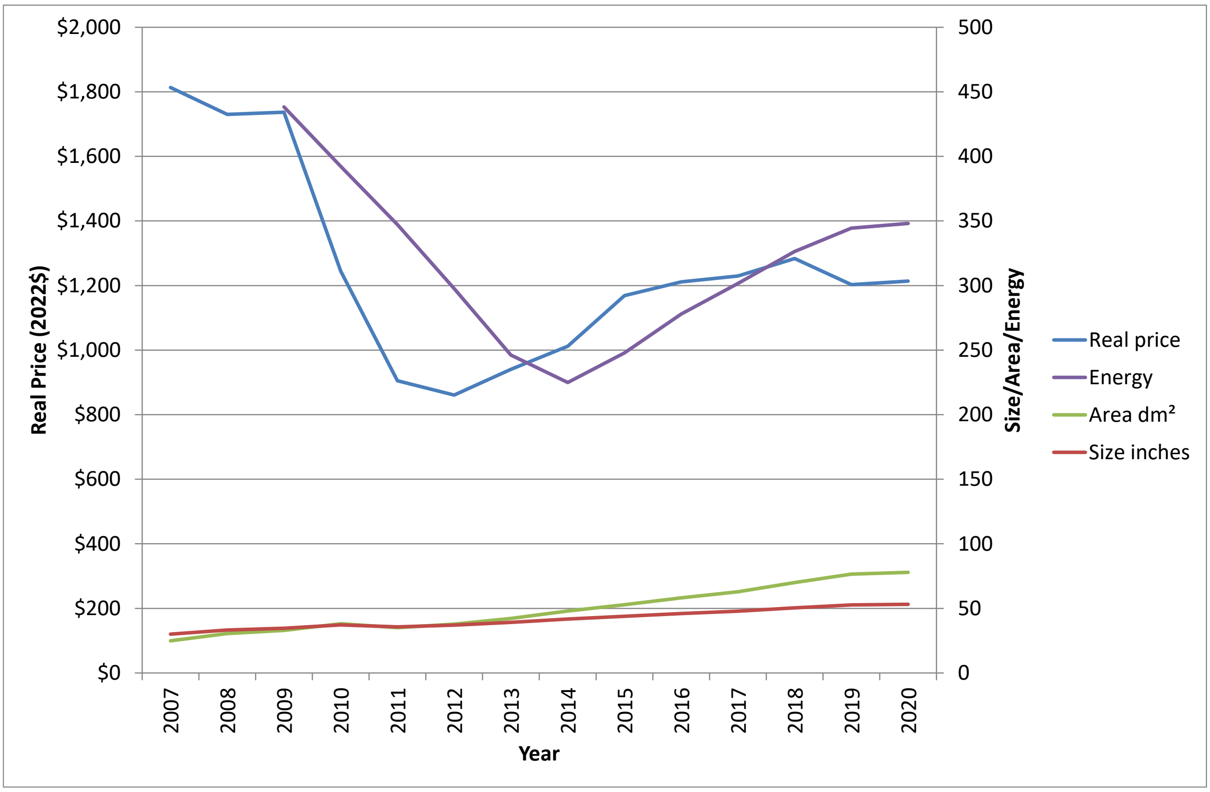

Figure 46: Long term trends in television attributes in Australia

The first important observation is that screen size (both the diagonal measurement and the screen area) have been increasing steadily across the whole period. The rate of increase is 4.5% per annum for screen diagonal and 9.2% per annum for screen area (these are in line as the area is a function of the square of the diagonal length). It is important to note that screen area is one of the main drivers of energy consumption for electronic displays.

Real prices showed a dramatic fall from 2007 to 2012 during the height of the transition to flat screen technologies. This fall is equivalent to a 10% per annum decrease in real price. This occurred even as screen sizes continued to increase across the same period. Real prices then increased for 3 years and have been fairly steady since about 2015. This is despite the increasing screen size and the increased share of high resolution and feature laden televisions in recent years. From 2013 to 2020 real prices increased at around 3.7% per annum, although there has been little change for the past 5 years.

Energy consumption also shows some interesting trends over the period. Initially, once energy labelling and MEPS commenced in 2009, there was a rapid decrease in energy

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[35] See ABS 6401.0 Consumer Price Index, Australia for Weighted Average of Eight Capital Cities

consumption for the first four years of the program, with energy reductions of 13% per annum. While some of this can be attributed to labelling and MEPS, some of the change was also driven by technology change to LED backlights in LCD screens. After 2013, energy use has increased at a rate of 5% per annum.

Screen luminance has a strong influence on television energy consumption. When the trends in energy and luminance are examined over the period, it is clear that there is a relationship, as illustrated in Figure 47. When these values are normalised to the minimum that occurs over the period as shown in Figure 48, it is clear that luminance explains some of the change in energy consumption, but not all of the change.

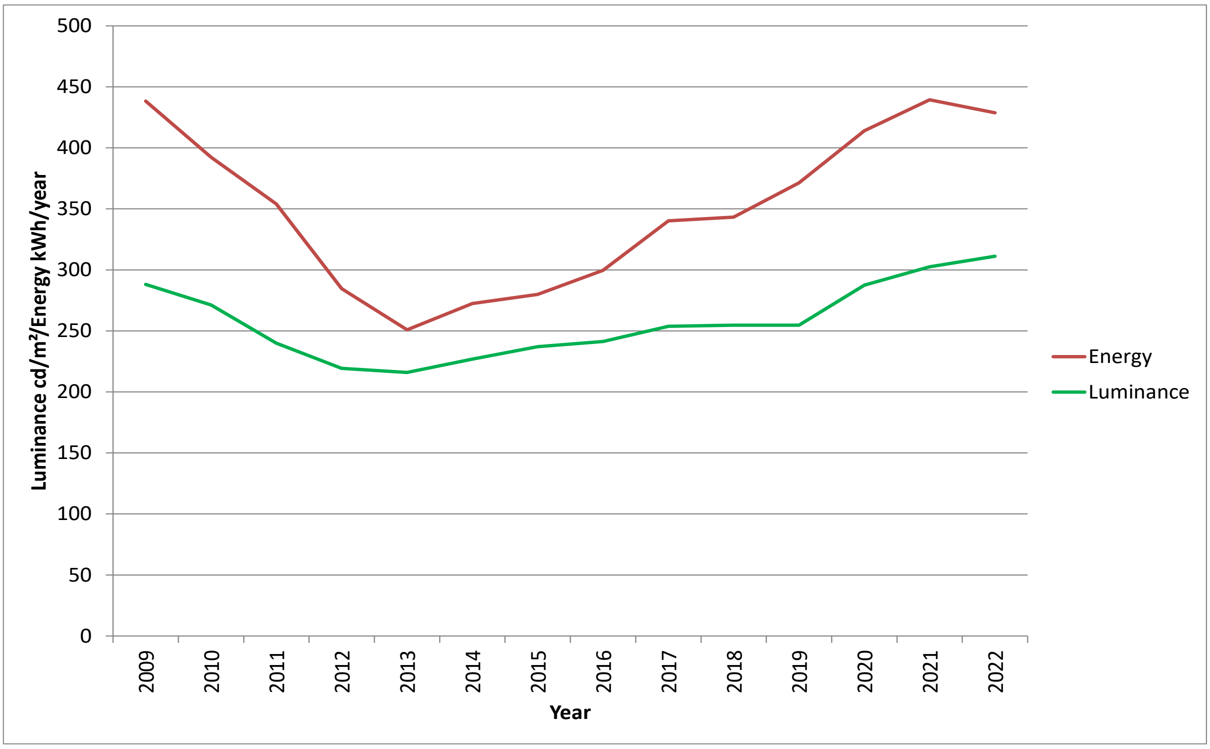

Figure 47: Trends in registered energy and luminance for televisions for all approved GEMS records. Data is based on registrations approved in the nominated year and is not sales weighted.

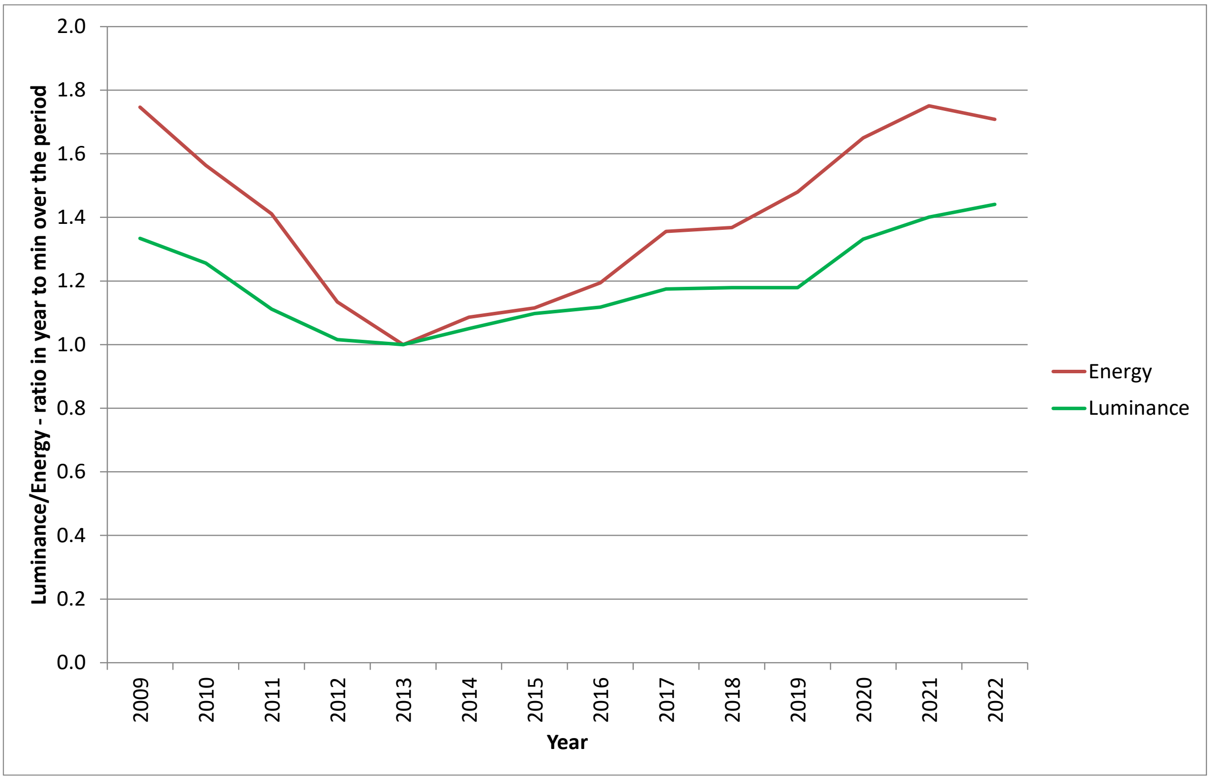

Figure 48: Relative changes in energy and screen luminance for televisions over the period 2009 to 2022 (based on min).

Detailed test data shows that all televisions increase luminance faster than power across their normal operating range. This depends partly on the screen size (as any fixed power component is a larger share for smaller screens), but typically a 100% increase in screen luminance would result in about a 40% increase in total power consumption. The 35% decrease in average luminance from 2009 to 2013 would normally be expected to result in about a 25% reduction in power, but the actual power reduction was 75%, suggesting a significant improvement in efficiency. From 2013 to 2022, luminance increased by 42%, which would normally be expected to result in a 30% increase in power, but the actual power increase was 75%. This appears to be driven by significant increases in screen size and screen resolution.

Another way of looking at the trends in energy is to measure the changes in energy intensity over time. One way to do this is to calculate the energy per unit area (while ignoring screen luminance). It is also possible to develop a function that includes screen luminance. These so-called efficiency metrics give a raw impression of what is driving energy, but they are somewhat imperfect as energy per unit of area tends to have some positive bias for larger screens. These two metrics are illustrated in Figure 49. Energy per unit area has been flat since 2014. Energy per unit area per unit of luminance has continued to decrease since 2014, albeit at a slow rate. This suggests that there is some improvement in the efficiency of light production from the television, but in practical terms, the overall energy is increasing due to increased size, luminance and screen resolution over time.

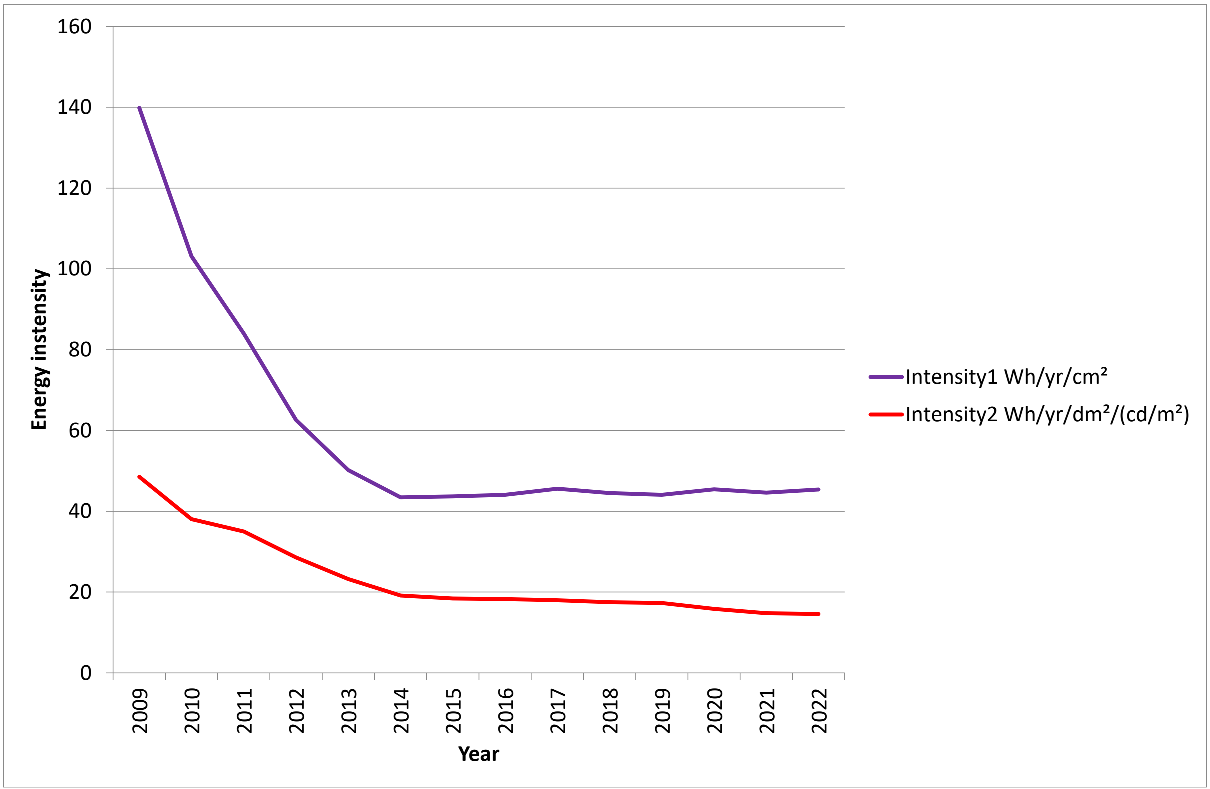

Figure 49: Trends in television energy intensity over time

The conventional economic theory with respect to energy consumption and product prices is that more efficient products are more expensive to make and therefore, any policy that forces a reduction in energy consumption of new products offered for sale should result in some price increase in the remaining products. For utilitarian products such as refrigerators, detailed market analysis showed that there is some negative correlation between energy[36] and price, but in general terms, these relationships are fairly weak. For televisions, there seem to be a range of different drivers.

A detailed analysis of 800 television models sold in 2020 in Australia was undertaken as part of the analysis for this CRIS. This examined actual price paid as well as the energy consumption of these models. Firstly, products were split into different categories that had similar features and resolutions as follows:

- LCD (LED) screen with standard definition
- LCD (LED) screen with high definition
- LCD (LED) screen with 4k resolution
- LCD (LED) screen with 8k resolution
- OLED screen with 4k resolution

The largest category was LCD (LED) screens with 4k resolution, so this category is used as an illustrative example for the analysis undertaken. Firstly, the relationship between

[36] A negative correlation between price and energy would see prices increase if energy consumption was forced to decrease, which is the expected relationship.

screen area and price was examined as illustrated in Figure 50. Note that the regression line shown is sales weighted – it takes account of the magnitude of the sales for each record when determining the least squares calculation. There were evidently some models with a small market share that were very expensive, but these only exert a very small influence on the regression line. For this product category the R^2 of the area-price regression line is 0.52.

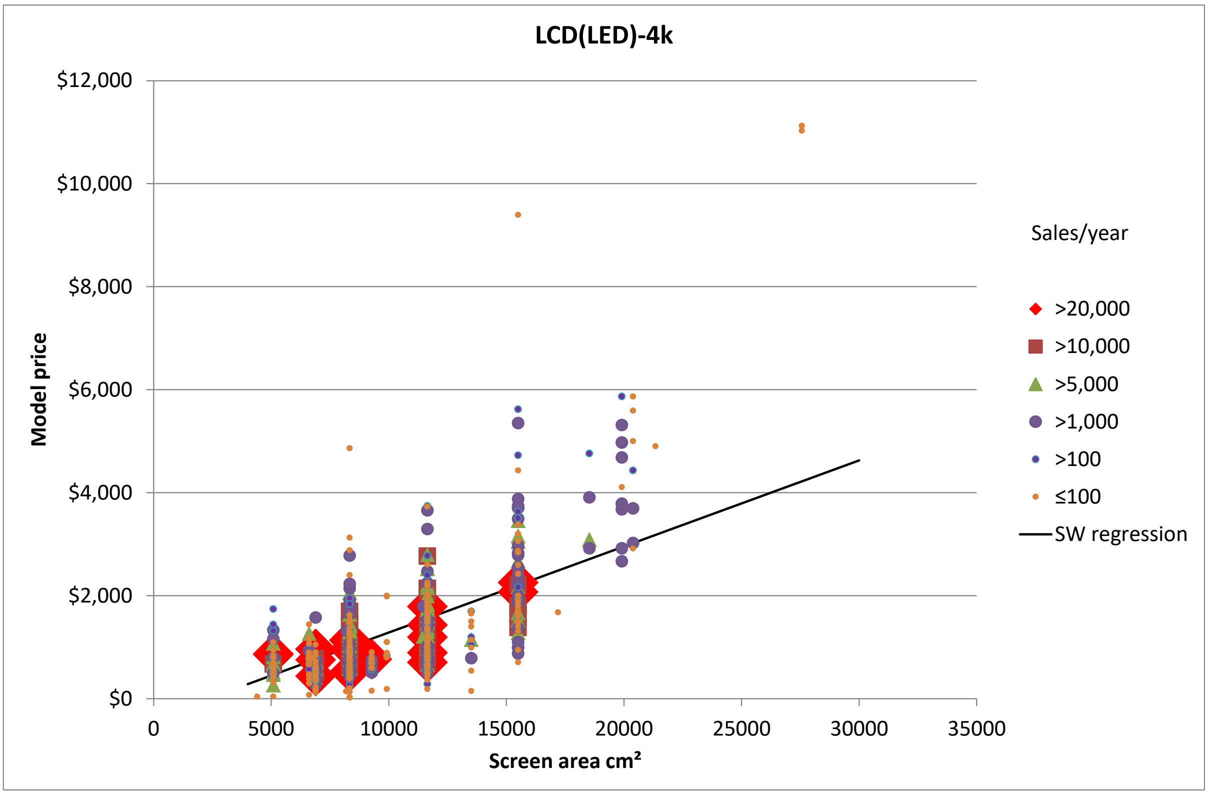

Figure 50: Relationship between screen area and price for televisions sold in 2020, Australia

The next step was to determine a similar relationship between screen area and energy consumption, as shown in Figure 51. For this product category the R^2 of the area-price regression line is 0.69.

From these two figures, a value for normalise price and normalised energy was then calculated. The normalised price is the actual price over the sales weighted regression price. Televisions that are more expensive than average for the given size have a value greater than 1. A similar calculation was then done to determine normalised energy, which is the actual energy over the sales weighted regression energy. Televisions that use more energy than average for the given size have a value greater than 1. The third step in the process was to undertake a sales weighted regression analysis of the normalised energy versus the normalised price. The intent was to show whether products that are more expensive than average use more or less energy than average.

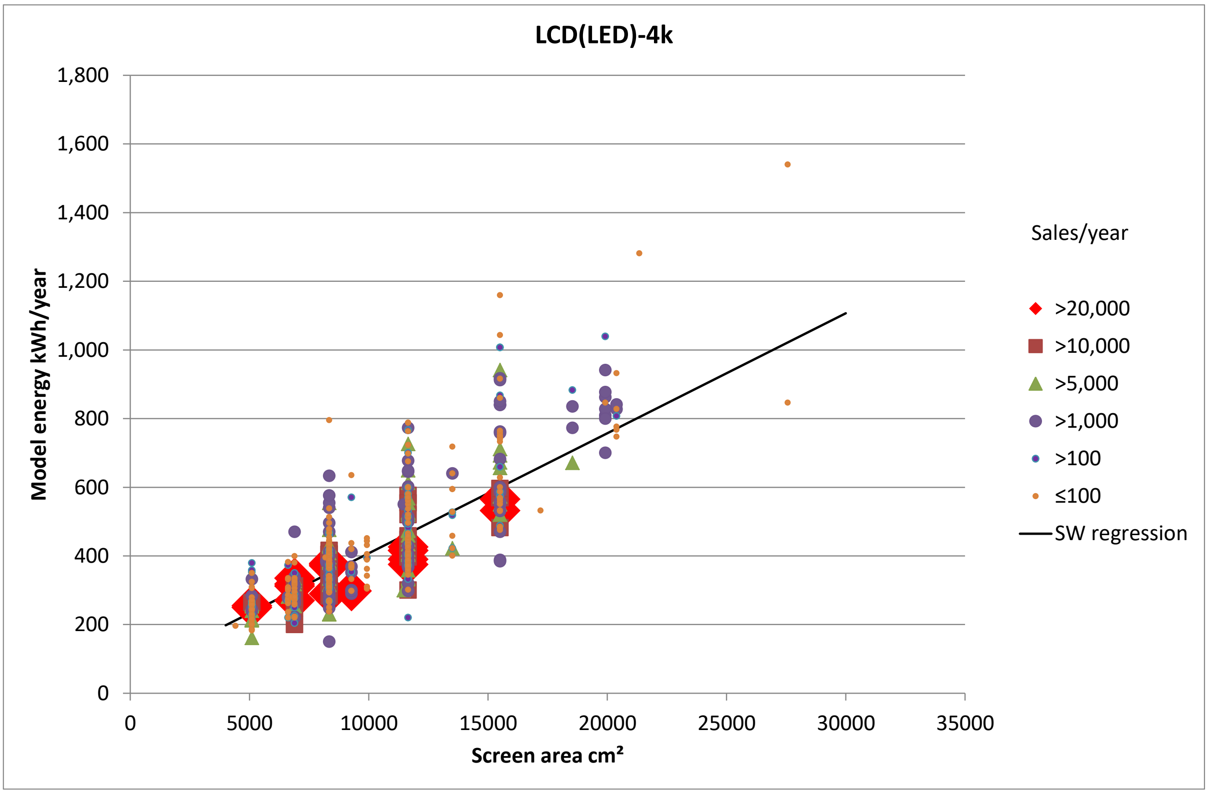

Figure 51: Relationship between screen area and energy for televisions sold in 2020, Australia

The results for LCD (LED) screens with 4k resolution are illustrated in Figure 52. Note that the regression line passes through the point where both normalised energy and normalised price are equal to 1.0.

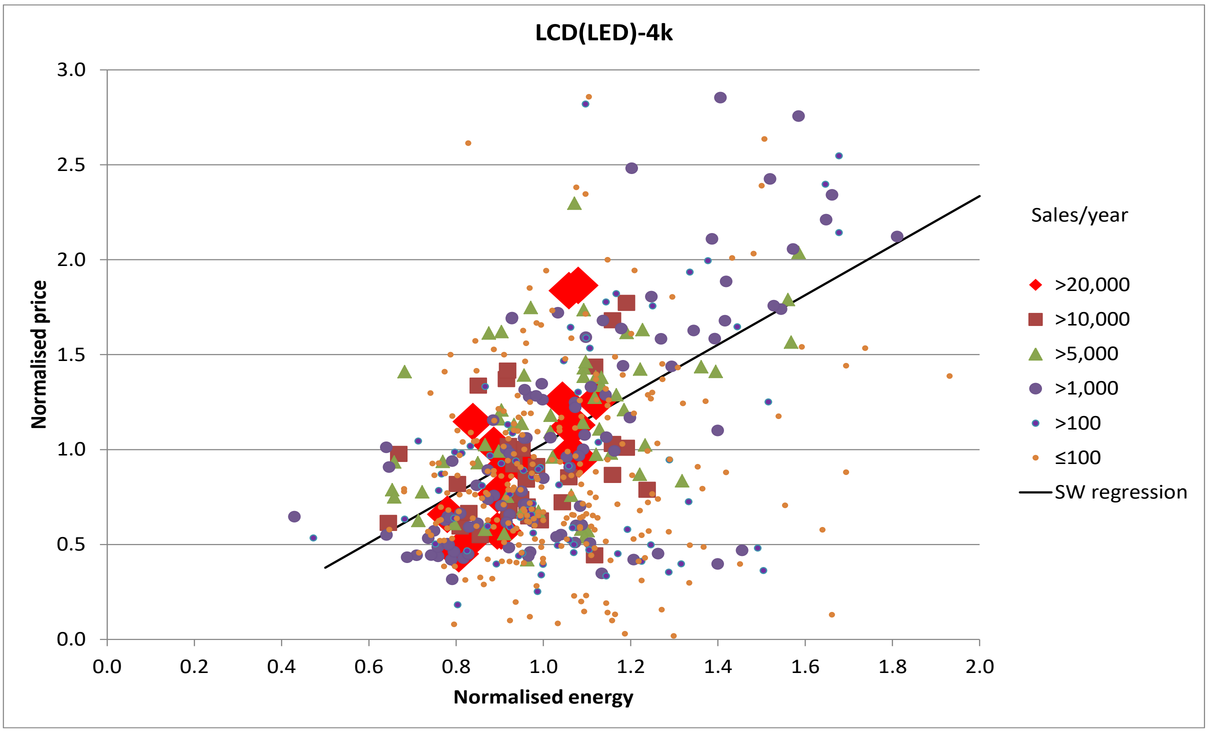

Figure 52: Normalised energy versus normalised price for LCD (LED) 4k televisions, Australia

For this product category, the R^2 of the normalised energy-normalised price regression line is 0.35, which is remarkably strong. This category of products had the largest number of models and also had the highest values of R^2 for all of the regression calculations. All five product categories examined for this study showed a positive correlation between energy and price. This seems to provide a definitive result that shows that higher priced televisions use more energy. This is the opposite of what would normally be expected from traditional economic theory. Applying this data as it stands would mean that the implementation of ever more stringent MEPS would result in lower product purchase prices which in turn would result in increased benefits on top of the energy savings alone.

The regression data above was explored to see whether price or energy were associated with higher screen luminance levels. Both higher price and higher energy are associated with brighter screens as illustrated in Figure 53 and Figure 54. This confirms the previous analysis that showed that more expensive televisions used more energy, in part because they tend to be brighter. Screen luminance is clearly an attribute that manufacturers feel will be attractive to consumers (despite the negative energy impacts in terms of the label energy and star rating). Brighter screens require higher power backlights, which are more costly to build and keep cool during operation, so higher costs for brighter screens make sense. To some extent this is also true of larger very high-resolution screens, where light has to be pushed through smaller pixels, which requires higher backlight levels and lower apparent efficiency.

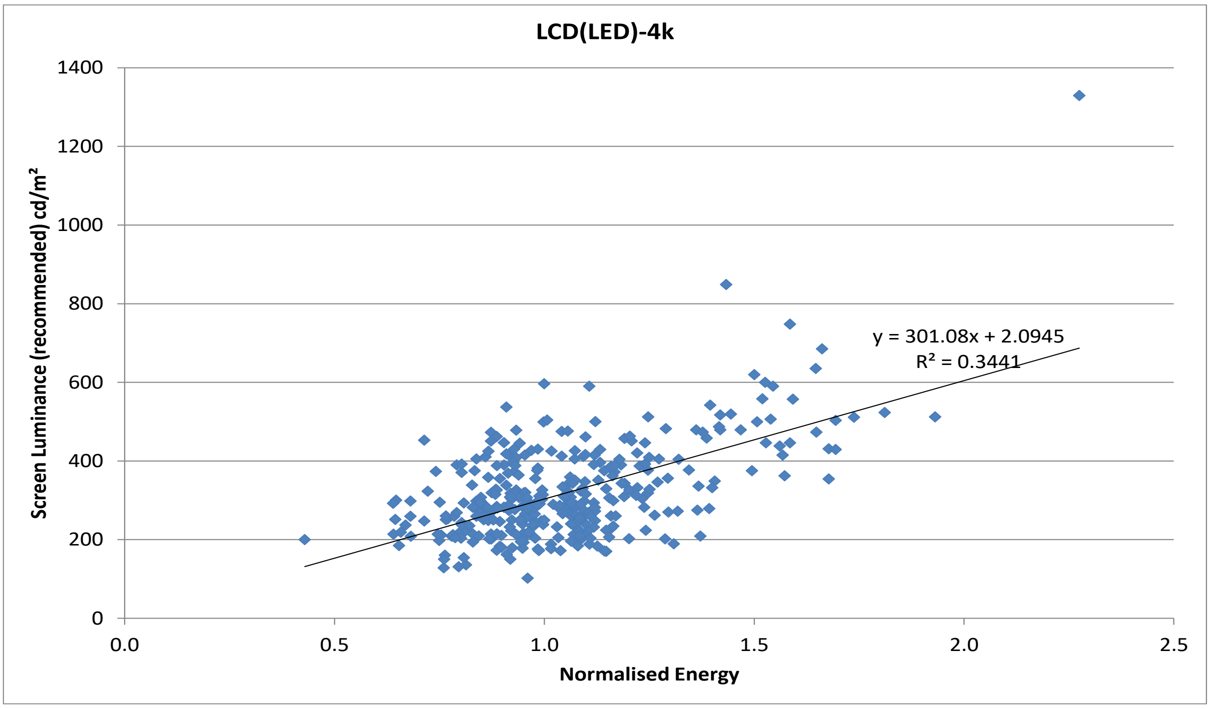

Figure 53: Screen luminance as a function of normalised energy consumption for LCD (LED) 4k televisions.

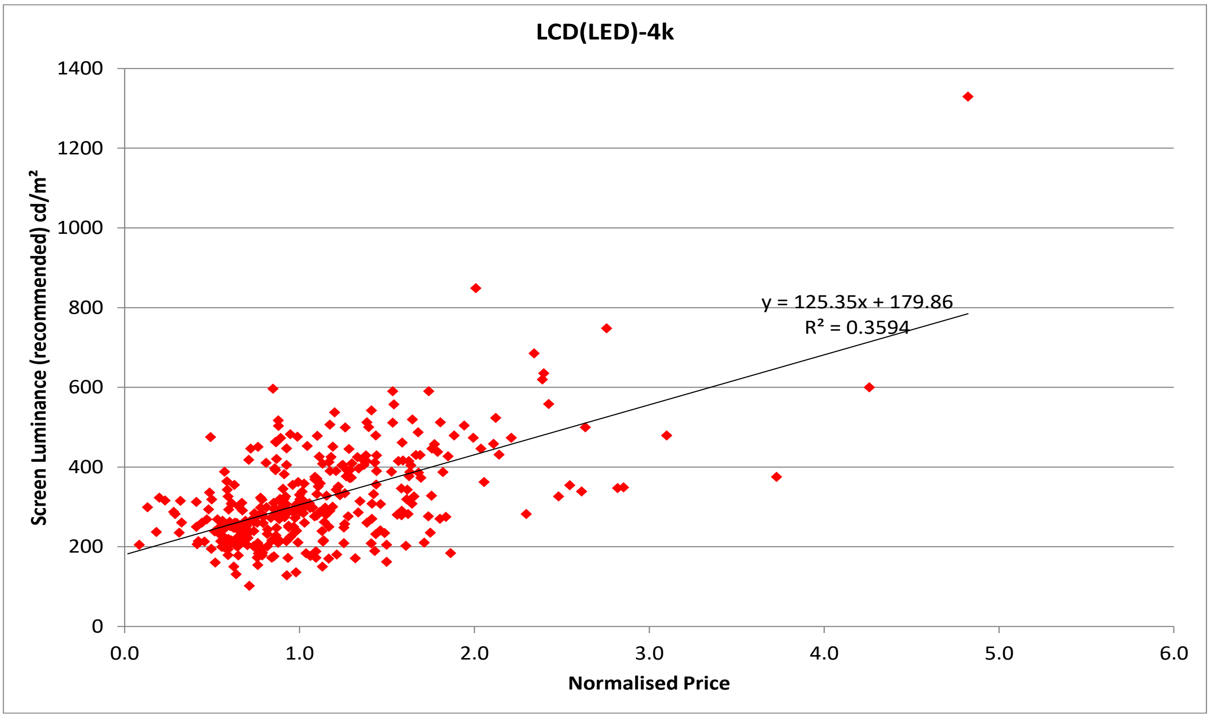

Figure 54: Screen luminance as a function of normalised price for LCD (LED) 4k televisions

This leads to the question on what price impact should be assumed after the implementation of the different options under consideration in this CRIS. The analysis above suggests that the introduction of more stringent MEPS will lead to lower product prices. This is not a defendable position for modelling of impacts, even though the data suggests that it may be true (based on the characteristics of the current market).

For the EU impact modelling for Ecodesign, it is stated that "For Electronic Displays there is no relation between efficiency and price. Direct input of annual prices used, same for BAU and ECO"[37]. This assumption suggests that there are no product price impacts taken into account when evaluating the impact of Ecodesign in Europe for electronic displays. While this may be true in practice, it does potentially underestimate overall costs.

The slope of the energy price regression undertake for LCD (LED) 4k televisions is +1.3 (meaning a 1% increase in energy would result in a 1.3% increase in price). For modelling purposes it is proposed that a price energy coefficient of -0.1 be used to estimate additional product costs after the imposition of MEPS (i.e. a 10% reduction in energy will result in a product cost increase of 1%). This is comparable to the value for price-energy established for household refrigerators in the 2017 RIS[38] but for that analysis the data showed a negative slope for the correlation. Sensitivity analyses at a price energy coefficient of -0.2 and -0.05 were also modelled for comparative purposes.

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[37] Ecodesign Impact Accounting Annual Report 2020, prepared by VAN HOLSTEIJN EN KEMNA (VHK), May 2021

[38] Decision RIS: Household Refrigerators and Freezers, 28 Nov 2017

Under the EU 2023 MEPS proposal, it is expected that the energy impact will be of the order of 20% for televisions, which would result in a product price increase of 2% overall. As the expected impacts are quite varied across different product categories, the price impacts are also expected to vary considerably for different parts of the market.

Computer Monitors

Long terms trends in key characteristics for computer monitors are illustrated in Figure 55.

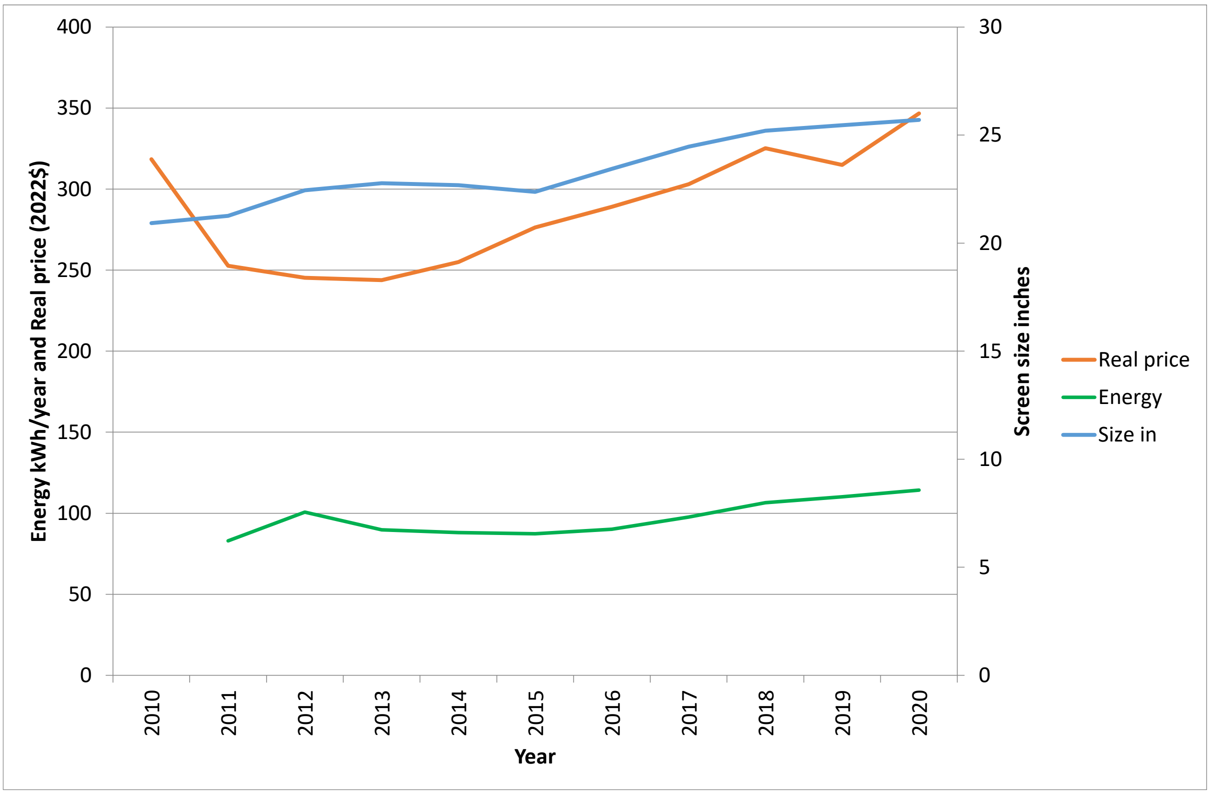

Figure 55: Long term trends in computer monitor attributes in Australia

Firstly, screen diagonals have been increasing at about 2.1% per annum since 2010 and this appears to be quite steady. This equates to an annual increase in screen area of 4.1% per annum. Over the same period, real computer monitor prices have been increasing at 3.6% per annum (2011 to 2020), which is in line with screen area increases. Energy consumption over there period has also increased 3.6% per annum[39], which is comparable to price and screen area. Unlike televisions, the changes over time have been less volatile. In the registration system, the brightest recommended screen luminance level is recorded and this has been tracked over time as illustrated in Figure 56. This has been relatively stable, as has the energy consumption. This shows that screen luminance is playing a less confounding role in the analysis of price and energy (when compared to televisions).

[39] Note that a relatively small share of models had energy data available, especially in the period before 2015. Registration data suggests that energy consumption has been more stable over time.

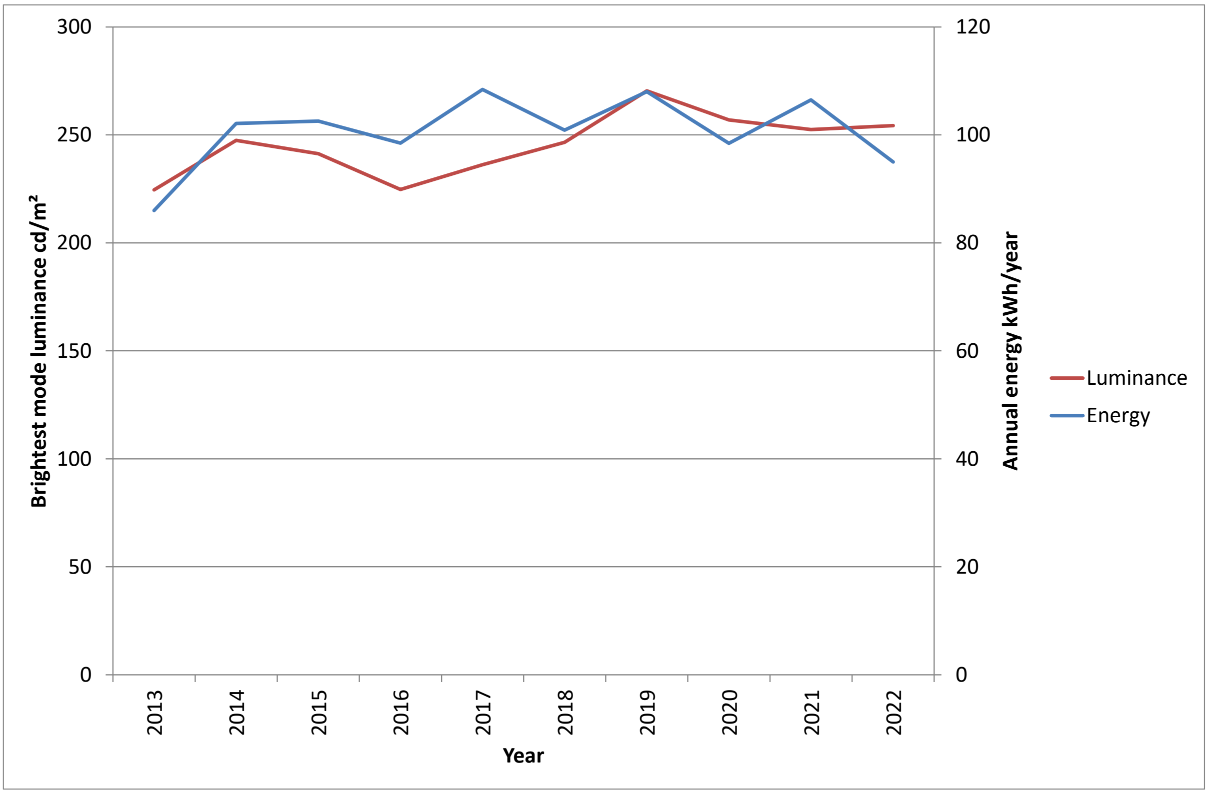

Figure 56: Trends in energy and brightest mode luminance for computer monitors from GEMS registration data

It is also useful to examine the energy intensity of computer monitors over time, as illustrated in Figure 57. Both metrics show some ongoing improvement over time, but part of this apparent improvement will be due to increases in screen size. This is because a pure area-based efficiency algorithm will also have some inherent positive bias towards larger screen sizes as there are some fixed energy components that are independent of screen size.

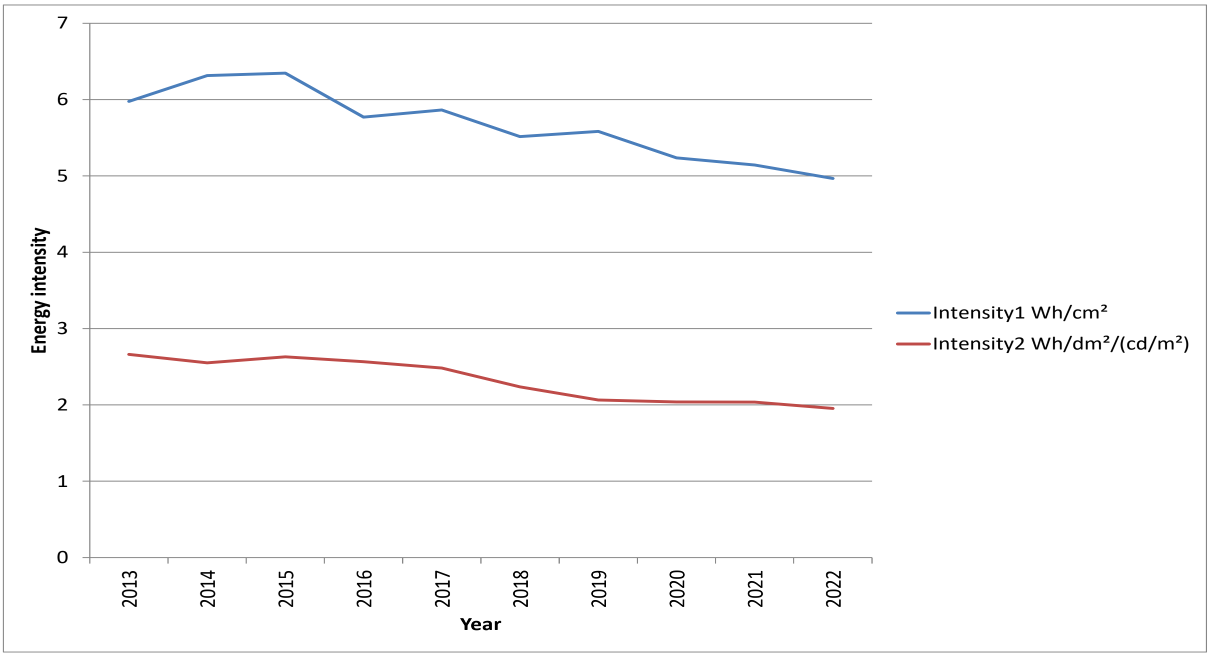

Figure 57: Trends in energy intensity of computer monitor GEMS registrations

A similar analysis on the relationship between price and energy consumption was also undertaken for computer monitors. This analysis was not sales weighted, but the results appear to be similar. Firstly, a regression of size versus price paid and a second regression of size versus energy consumption was undertaken for computer monitors as illustrated in Figure 58 and Figure 59.

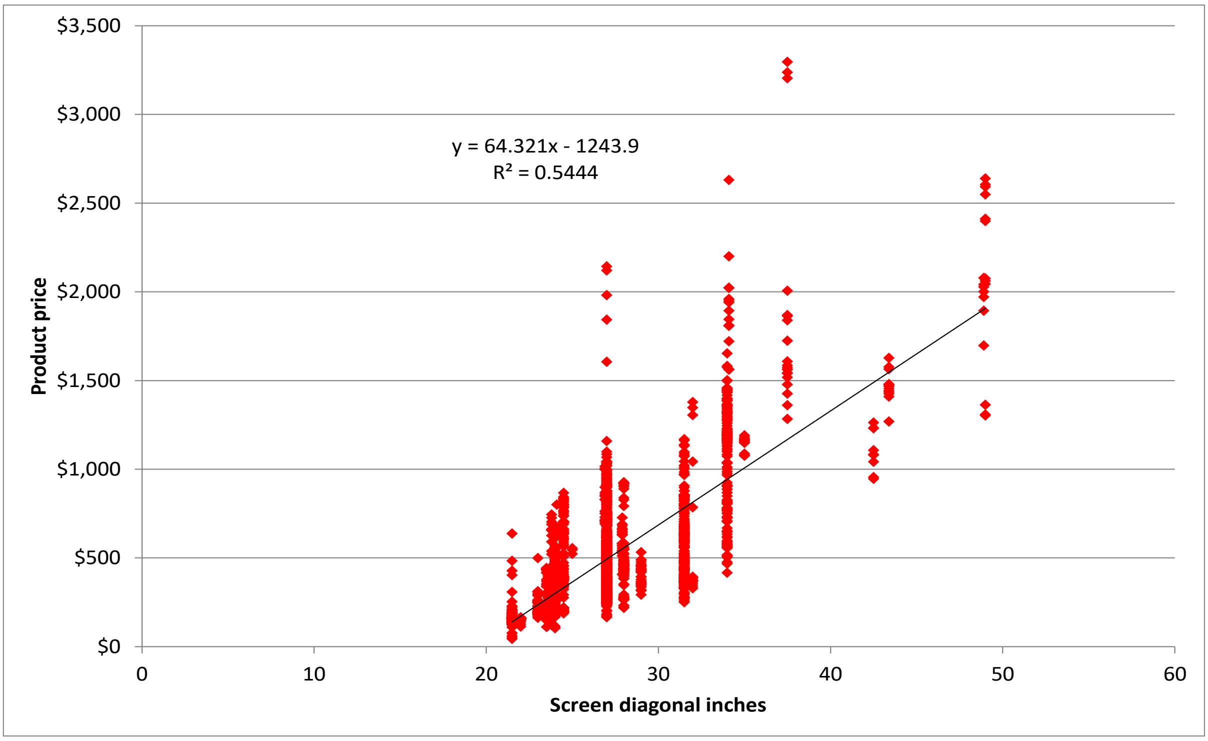

Figure 58: Relationship between screen diagonal and price for computer monitors sold in 2018-2020, Australia

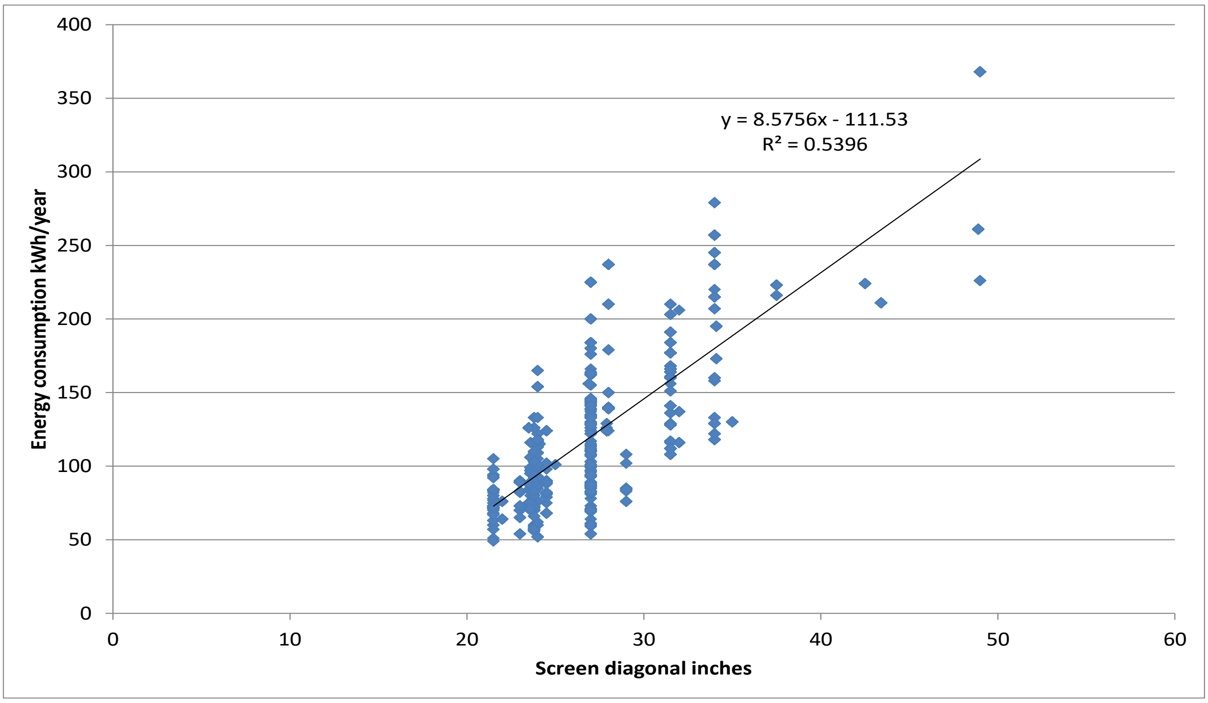

Figure 59: Relationship between screen diagonal and energy for computer monitors sold in 2018-2020, Australia

Using the regression lines shown, a value for normalised price and normalised energy can be calculated as the actual value divided by the regression value. A normalised value of more than 1.0 shows that the product is more expensive or uses more energy than an average computer monitor. When we plot normalised energy versus normalised price, we see a similar relationship as was found for televisions, but the slope is not as steep and the regression is not as strong, as illustrated in Figure 60 (note that this is not sales weighted). The trend shows that more expensive computer monitors tend to use more energy (when corrected for size). In order to better understand the underlying drivers, the impact of screen luminance and screen resolution was also examined.

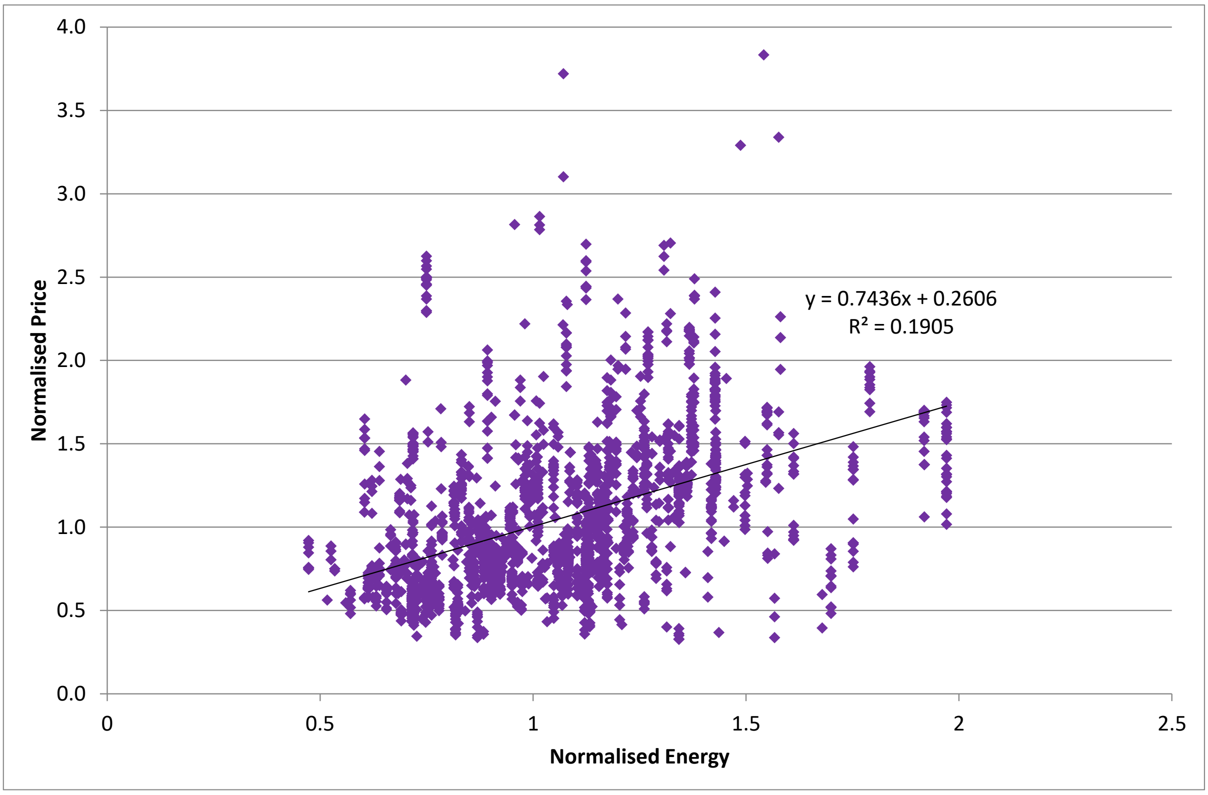

Figure 60: Normalised energy versus normalised price for computer monitors sold in 2018-2020, Australia

Data in Figure 61 suggests that screen luminance has little to no impact on the energy consumption of computer monitors, as previous analysis suggested. Further investigations explored whether screen resolution had any significant impact on energy or price, as illustrated in Figure 62 and Figure 63. Both of these data sets show that screen resolution has an extremely weak impact on price and energy (note the extremely low R^2 values).

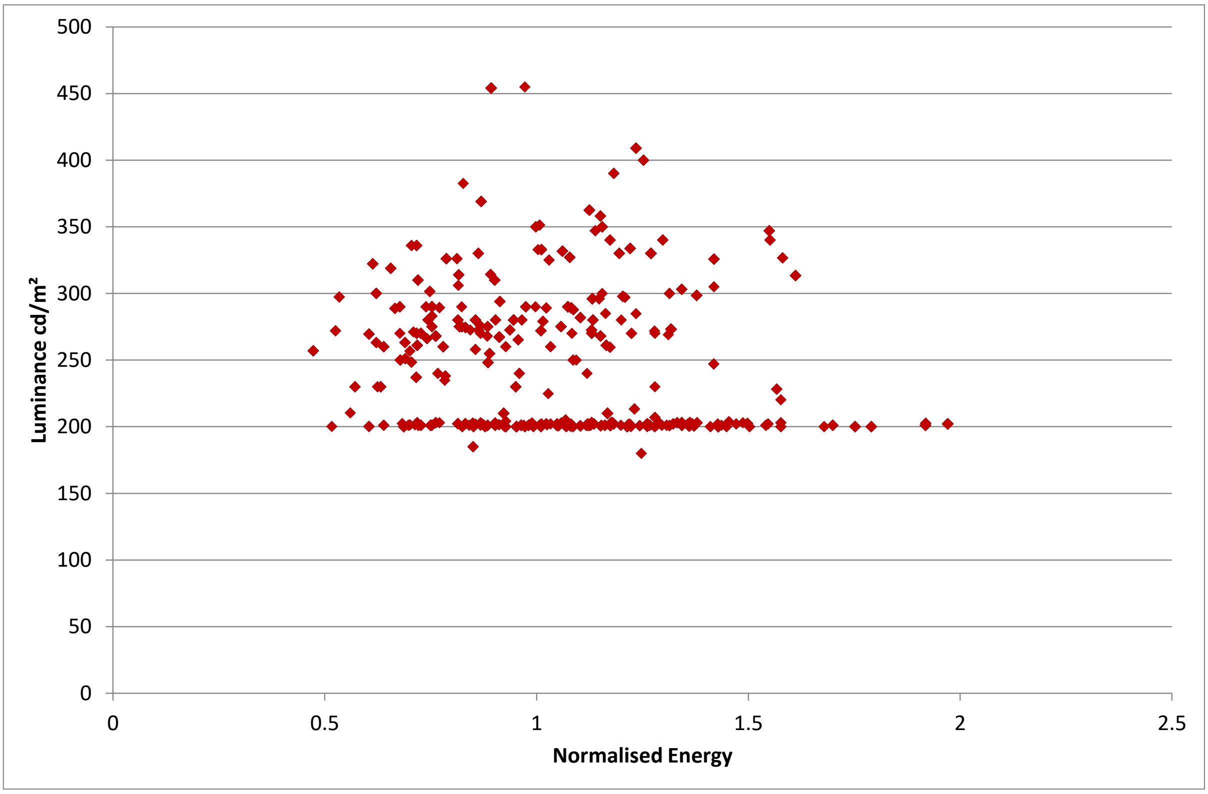

Figure 61: Normalised energy versus brightest screen luminance for computer monitors sold in 2018-2020, Australia

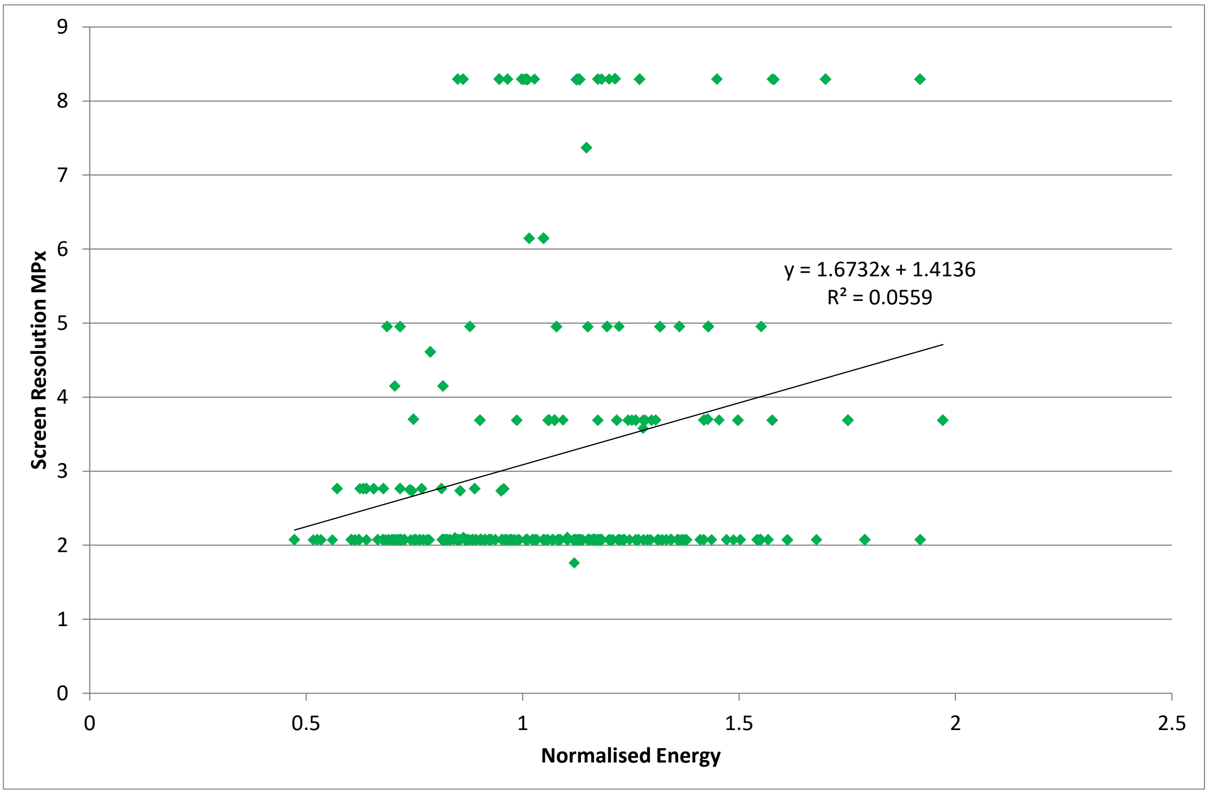

Figure 62: Normalised energy versus screen resolution for computer monitors sold in 2018-2020, Australia

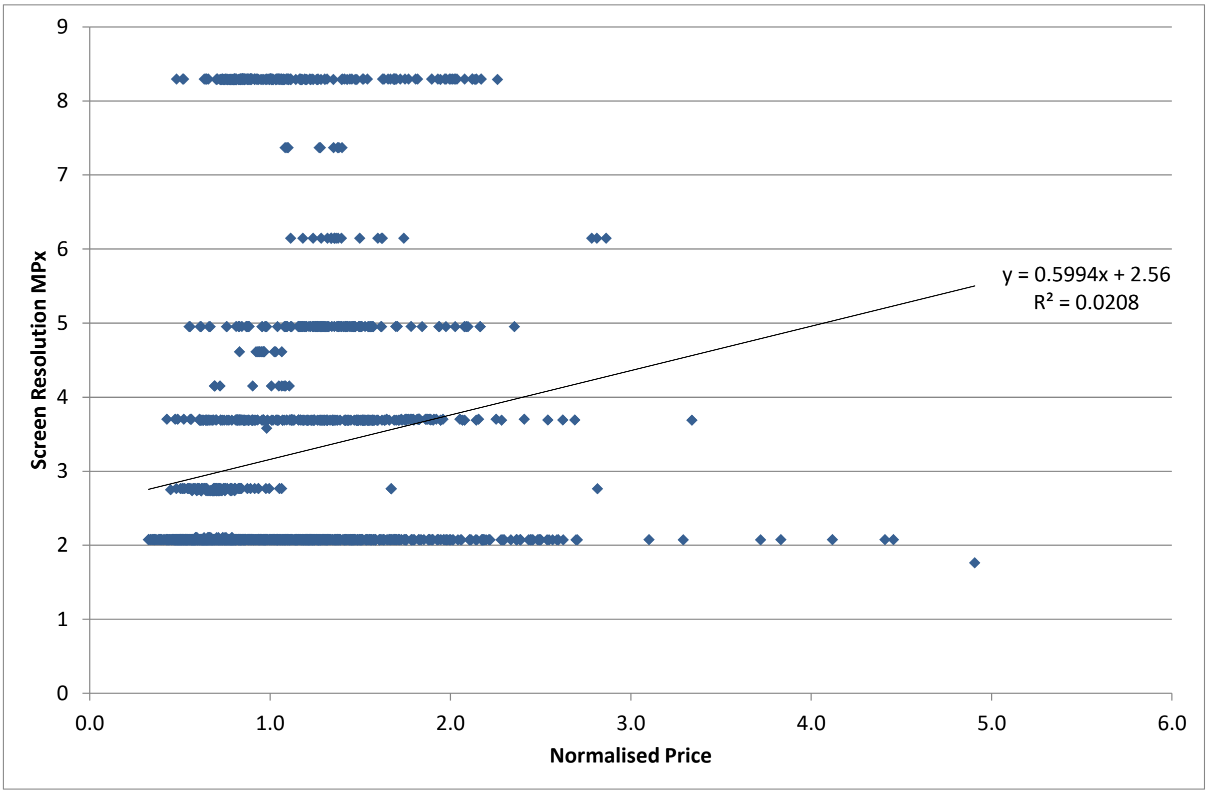

Figure 63: Normalised price versus screen resolution for computer monitors sold in 2018-2020, Australia

This analysis concludes that for computer monitors, there is some relationship between energy and price in that monitors that use more energy are more expensive. Other parameters such as screen luminance and resolution do not appear to have a strong influence on these relationships.

For modelling for this CRIS, it is necessary to make assumptions regarding the impact of the proposed policies on product prices. The data available suggests that energy reductions from MEPS will reduce purchase prices but, as for televisions, this is likely to create perverse modelling outcomes (increasingly more stringent MEPS produce ever greater benefits). For modelling purposes it is proposed that the same price energy coefficient of -0.1 be used (same as televisions) to estimate additional product costs after the imposition of MEPS (i.e. a 10% reduction in energy will result in a product cost increase of 1%). Under the EU 2023 MEPS proposal, it is expected that the energy impact for computer monitors will be of the order of 10%, which would result in a product price increase of 1% overall.

Policy issues and considerations

The EU MEPS proposal does not include screen luminance in the current efficiency metric (it uses a metric based on on-mode power and screen area only). Because luminance is such an important factor in the power consumption of a television, it is necessary to control some aspects of luminance to ensure that screens are not dimmed so much in the recommended preset picture setting as to be unsuitable for normal use. The EU approach to controlling luminance issues is moderately effective, but not perfect. This is similar to the luminance requirements that have been in force in Australia and New Zealand since the introduction of MEPS and energy labelling. The data on size, performance and price in Australia and New Zealand for digital signage displays was limited. The same price energy coefficient has been assumed for digital signage displays as for televisions and computer monitors.

The other issue to consider is the impact of Automatic Brightness Control. For modelling purposes, it is assumed that ABC, when activated, will save at least as much energy as the energy credit provided in the EU regulations (10%). In reality, savings may be larger than this, but this is difficult to quantify accurately without field measurements. While a majority of new televisions now include ABC, only around 18% of televisions in the EPREL database listing for Europe (covering more than 10,000 television-models) have an ABC control that complies with the EU power reduction envelope.

No data on the presence of ABC (or not) for each model is recorded in the AU/NZ registration system for televisions, but it is known that many of the major suppliers do have some ABC features present in some preset picture settings. It is unclear why the proportion of products with complying ABC controls is so low in Europe, but this is possibly because many do not meet the EU persistence requirements across different preset picture settings (ABC has to remain as the default when selecting a new PPS).

Around 3% of computer monitors listed on the EU EPREL database have an ABC control that complies with the EU power reduction envelope. The presence of ABC is recorded in AU/NZ registrations, and about 5% of recently registered models (after 1 January 2019) claim to have an ABC feature. No performance data regarding the ABC feature is recorded in the AU/NZ registration database. For computer monitors, it is also assumed that energy saved with ABC active will be at least as much as the 10% allowance in the EU regulations, so no explicit adjustment for this feature is included.

Impact of proposed policies on future energy characteristics

For modelling purposes, a wide range of characteristics are projected to estimate the base case energy consumption with no change to the current regulations. Key characteristics projected are:

- Market share by product category
- Size of the electronic display within each category
- Total sales of products
- Ownership levels and stock
- Real changes in product prices over time
- Energy consumption characteristics.

For stock modelling purposes, it is assumed that the first four parameters listed above are not affected by the introduction of new energy policies such as MEPS, so these parameters remain unchanged for all scenarios. For modelling it is assumed that energy characteristics (primarily on-mode power for the policies considered) will be impacted by the introduction of new MEPS and labelling policies as set out previously. As noted in the previous section, modelling also assumes that the introduction of new MEPS and labelling policies will have some impact of real product prices and total purchase costs. Secondary effects that relative changes in prices may have on the market share of some product categories are not considered in the model.

Appendix E – Sensitivity analysis

A sensitivity analysis was conducted for the benefit cost ratios and net benefits for the following variables. This analysis was undertaken for all screens combined and summarised in the tables below, with all other variable held constant and at their central values.

- Discount rates
- Cost of emissions

Discount rates

Australia

Policy option - Adopt EU 2023 Regs in 2024

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	4,540	2,740	1,460	947
Benefit Cost Ratio	6.96	5.87	4.80	4.19

Policy option - Adopt EU 2023 Regs in 2025

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	4,286	2,569	1,360	876
Benefit Cost Ratio	7.02	5.92	4.84	4.22

Policy option – Staged introduction

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	3,970	2,350	1,230	777
Benefit Cost Ratio	6.87	5.78	4.69	4.08

New Zealand

Policy option - Adopt EU 2023 Regs in 2024

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	252	177	106	66
Benefit Cost Ratio	4.38	3.91	3.34	2.89

Policy option - Adopt EU 2023 Regs in 2025

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	238	166	99	61
Benefit Cost Ratio	4.41	3.94	3.36	2.91

Policy option – Staged introduction

Discount rates	0%	3%	7%	10%
Net benefit NPV $m	219	152	89	54
Benefit Cost Ratio	4.31	3.84	3.27	2.81

Cost of emissions

Australia

Policy option - Adopt EU 2023 Regs in 2024

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	1,330	1,370	1,460	1,520	1,740
Benefit Cost Ratio	4.45	4.56	4.80	4.95	5.50

Policy option - Adopt EU 2023 Regs in 2025

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	1,240	1,280	1,360	1,420	1,610
Benefit Cost Ratio	4.49	4.61	4.84	4.98	5.54

Policy option – Staged introduction

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	1,120	1,150	1,230	1,270	1,450
Benefit Cost Ratio	4.37	4.48	4.69	4.83	5.36

New Zealand

Policy option - Adopt EU 2023 Regs in 2024

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	97	103	106	110	97
Benefit Cost Ratio	3.14	3.28	3.34	3.42	3.14

Policy option - Adopt EU 2023 Regs in 2025

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	91	97	99	103	91
Benefit Cost Ratio	3.17	3.30	3.36	3.45	3.17

Policy option – Staged introduction

Cost of emissions	Zero	Low	Medium	High	High Impact
Net benefit NPV $m	82	87	89	93	82
Benefit Cost Ratio	3.07	3.20	3.27	3.35	3.07

Appendix F – IEC standards history

The history of IEC publications are as follows:

- IEC62087 Edition 1 was published in 2002
- IEC62087 Edition 2 was published in 2008 (AS/NZS62087.1-2010)(identical)
- IEC62087 Edition 3 was published in 2011
- IEC62087 was then published in parts as follows:
    - IEC 62087-1:2015 *Audio, video, and related equipment - Determination of power consumption - Part 1: General*
    - IEC 62087-2:2015 *Audio, video, and related equipment - Determination of power consumption - Part 2: Signals and media*
    - IEC 62087-3:2015 *Audio, video, and related equipment - Determination of power consumption - Part 3: Television sets*
    - IEC 62087-4:2015 *Audio, video, and related equipment - Determination of power consumption - Part 4: Video recording equipment*
    - IEC 62087-5:2015 *Audio, video, and related equipment - Determination of power consumption - Part 5: Set-top-boxes (STB)*
    - IEC 62087-6:2015 *Audio, video, and related equipment - Determination of power consumption - Part 6: Audio equipment*
    - IEC 62087-7:2018 *Audio, video and related equipment - Methods of measurement for power consumption - Part 7: Computer monitors*

IEC 62087: Parts 2 and 3 was updated and published in February 2023. This is equivalent to CENELEC EN 62087 Parts 1 to 3 (2016) with the amendments from EU Regulations.

It is expected that a further revision will commence with potential release in 2024 or later. The US Consumer Technology Association has released its latest television test method CTA-2037D. It is likely that the 2024 (or later) IEC test method will be equivalent to CTA-2037D.

Glossary

Term	Definition
$m	Million dollars
4k televisions	A television with a horizontal resolution of approximately 4000 lines, normally 3840
8k televisions	A television with a horizontal resolution of approximately 8000 lines, normally 7680
ABC	automatic brightness control
ARA	Australian Retailers Association
ASFBEO	Australian Small Business and Family Enterprise Ombudsman
BAU	Business as usual
cd	Candela (cd) is a unit of measurement of luminous intensity. It is the amount of light radiated in a given direction.
CESA	Consumer Electronics Suppliers Association (Australia)
CHOICE	magazine of the Australian Consumers' Association (consumer advocacy group)
cm	centimetre
CO2-e	Carbon dioxide equivalent
Computer monitor	screen that displays visual information from a computer, workstation or server as its primary function, intended for one person for close viewing, such as in a desk-based environment
CRIS	Consultation Regulatory Impact Statement
CRT	cathode ray tube televisions
CTA	Consumer Technology Association (USA)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
Digital signage display	Screen for public and/or non-focussed viewing, often long range. The European regulations define a digital signage display as an electronic display that is designed primarily to be viewed by multiple people in non-desktop based and non domestic environments.
dm^2	Square decimetre
E3 Program	Equipment Energy Efficiency Program (Australia and New Zealand)
EC	European Commission
EEC	Energy Efficiency Council (Australia)
EEC Act	Energy Efficiency and Conservation Act (New Zealand)
EECA	Energy Efficiency and Conservation Authority (New Zealand)
EEI	Energy efficiency index
EPREL	European Product Registry for Energy Labelling (EU)
ERL	Energy rating label
EU	European Union
EU 2021	MEPS levels defined in Regulation (EU) 2019/2021 in force from 1 March 2021 to 28 February 2023.
EU 2023	MEPS levels defined in Regulation (EU) 2019/2021 that come into force on 1 March 2023.
GHG	greenhouse gas emissions
GWh	gigawatt hour – unit of electrical energy
HD	high definition (1080 lines or more)
HDR	high dynamic range
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
kt	kilo tonnes (thousand tonnes)
kWh	kilowatt hour – unit of electrical energy

Term	Definition
LCD	liquid crystal display
LED	light emitting diode
m^2	square metre
MEPS	minimum energy performance standards
Micro-LED	MicroLED is an emissive display technology where the light level of each red, green, or blue sub-pixel is a small LED light source that can be controlled individually.
Mini-LED	An LED display technology that uses a full-array of small backlights arranged in a grid to provide backlight for an LCD TV. Mini-LED displays differ from traditional LED displays in that they may have a couple of orders of magnitude (e.g. thousands) more backlights in the full-array backlight. This enables higher contrast ratios through more localised dimming.
Mt	Mega tonnes (million tonnes)
NPV	Net present value
On-mode	'on-mode' or 'active mode' means a condition in which the electronic display is connected to a power source, has been activated and is providing one or more of its display functions
Preset Picture Setting (PPS)	A preprogrammed factory setting with pre-determined picture parameters such as brightness, contrast, colour, sharpness, etc.
SD	standard definition (up to 728 lines)
SDR	standard dynamic range
Shop configuration	'shop configuration' means the configuration of the electronic display for use specifically in the context of demonstrating the electronic display, for example in high illumination (retail) conditions and not involving an auto power-off if no user action or presence is detected
Specialist display	screen with specific industry/professional applications (for example, in medical applications)
Televisions	an appliance[40] for the display and possible reception of television broadcast and similar services for terrestrial, cable, satellite and broadband network transmission of analogue or digital signals, and includes: (a) a display or monitor with an inbuilt television tuner; (b) a display or monitor without an inbuilt television tuner sold in modular form; and (c) a television that has additional functions which are not required for its basic operation as a television
TV	television
UHD	Ultra high definition (usually more than 2 Megapixels and includes 4k and 8k displays)

[40] Definition from television determination

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